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ABSTRACT

Designed to provide a means of disseminating expert information on the use of modern communications for development, the goal of this book is to contribute to the equitable sharing of such knowledge globally, and ultimately to the more effective use of the most appropriate equipment available. The book is divided into nine chapters, as follows: (1) Global Telecommunications (focuses on the demand for investment in telecommunications and the advent of satellite communications); (2) Telecommunications Management (presents information on bridging the telecommunications gap, the increasing need for computer based network management systems, and maintaining telecommunications networks); (3) Telecommunications Equipment (acquaints the reader with fiber optic lines, copper cables, intercoms, and other products); (4) Rural Communications (supplies information on developing rural telecommunication networks); (5) Mobile Communications (contains the recent technological achievements in the field); (6) Digitisation and Information Technology (explains recent advances in digital networking and information technology systems); (7) Power (discusses the importance of an uninterruptible power supply); (8) Satellites (examines the progress in satellite communications); and (9) Broadcasting (offers information about several aspects of broadcasting). Advertiser information is presented, including a chart correlating items of equipment with 120 companies. (MS)

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CONTENTS

FOREWORD BY SIR DONALD MAITLAND

As Chairman of the Independent Commission for Worldwide Telecommunications Development, whose report 'The Missing Link' has become the byword for anyone concerned with telecommunications for development, Sir Donald Maitland is the ideal person to introduce this second edition of 'Developing World Communications' 26

GLOBAL TELECOMMUNICATIONS

The ITU and Technical Co-operation: New Moves for Development

1986 was a significant year for the relationship between developing countries and the International Telecommunication Union (ITU). It saw the establishment of a Centre for Telecommunications Development as part of the ITU, which is setting out to make the advancement of the telecommunications in Third World countries its specific concern. Richard Butler, Secretary-General of the ITU, explains both the background to its conception and its intentions 34

Finding New Finance

The demand for investment in telecommunications in developing countries is obvious. Yet conventional financing is unlikely to grow substantially. Bjorn Wellenius, Senior Economist in the Telecommunications Division of the Industry Department of the World Bank, looks at two methods of financing which could provide a richer future 40

Pooling Funds

Severe financial problems stand in the way of modernising and expanding communications networks. In Africa Kouassi Apetey, Deputy Director of the Department of Infrastructure and Industry at the African Development Bank, stresses the importance of co-operation and co-ordination in making sure that all available resources are used to the best advantage 46

A Lifestyle Revolution from the Sky

Until very recently, lack of communication with the outside world has been a fact of life for people living in isolated areas. All this is changing, however, with the advent of satellite communications. Charles Halton of the Department of Communications in Canberra, Australia, describes how the arrival of Aussat is transforming communications networks in the Australian outback 50

TELECOMMUNICATIONS MANAGEMENT

Linking the Islands

For the last three years, the South Pacific Telecommunications Development Programme has been studying ways of extending its telecommunications network and of adapting it to cater for telegraph and data services and television as well as voice transmission. E J Wilkinson of the South Pacific Bureau for Economic Co-operation reports on its progress 72

Teleports: A Growing Phenomenon

Economic activities have always needed a centre: first sea ports, then rail ports and airports. The latest development is the teleport. Chief Adebayo Adeleke, Chairman of the Africa and Middle East Region of the World Teleport Association, describes the enormous potential of this new phenomenon and its particular relevance for developing nations 76

Training Bridges the Telecommunications Gap

Telecommunications technology is an essential growth area for any developing country. Brian A Tickle, Deputy Chairman and Chief Executive Officer of Bell Canada International, highlights the vital ingredients for building up an effective and efficient telecommunications network 80

CONTENTS

Telecommunication Decisions for Tomorrow

Setting up or expanding a telecommunications network involves a whole chain of inter-related decisions – about investment, equipment, services and personnel. Eric Jamieson, Marketing Manager of Ferranti Industrial Electronics Ltd, stresses that potential growth, flexibility and financial considerations must be taken into account if these decisions are to be valid 83

Encouraging Expertise

Increased competition and commercialism within the telecommunications industry have brought an appreciation of the crucial need for high-quality managerial and technical training facilities, writes Dr George Newns, Business Development Director of British Telecom Overseas Division 85

Value For Money in Developing Communications

Faced with a multiplicity of products, telecommunications customers in developing countries must aim for a good balance of reliability and low costs in their purchases. Robin Dudney, a director of TanTech Ltd, a company providing marketing and management services to the telecommunications industry, and of Lake Electronics (UK) Ltd, puts the case for the small supplier 88

Network Management: Cutting Costs through Monitoring and Maintenance

The need for large-scale computer based network management systems is growing as the size and complexity of today's telecommunications systems increase, especially where maintenance resources are limited. T W Engelhart and Tom Mares of Datap Systems, outline the main elements of a progressive monitoring and maintenance system which could prove valuable to developing networks 92

Maintaining Network Performance

The variety of testing equipment available for telecommunications networks is now enormous. Paul Blakemore, Senior Product Manager, Telecommunications, of Marconi Instruments Ltd, reviews the field, with particular emphasis on PCM primary multiplexes and digital lines 96

Remote Testing: A Reliable Way of Finding the Faults

Maintenance of telecommunications networks is a major priority if a service is to run smoothly and cost-effectively writes Graham Powell, Managing Director of Vanderhoff Communications 100

TELECOMMUNICATIONS EQUIPMENT

Cost-Effective Transmission: Coaxial or Fibre Optic Lines?

Cable installation can be the greatest single expense involved in setting up a transmission network and therefore often need careful consideration. Patrice Desombre, General Manger of the Landline Systems division of Alcatel CIT, evaluates the relative merits of coaxial and fibre optic cables for wideband long-distance transmission 156

Copper Cable Stays the Course

The latest developments in fibre optic technology are being watched keenly by the telecommunications industry. Yet copper cable can meet the needs of digital communication both in terms of speed and efficiency. Thomas D Morocco, Field Project Manager, Applications Engineering, for the Network Products Division of the General Cable Company, puts the case for proven technology 160

Looking Ahead with Optical Fibre

Increasingly, optical fibre transmission is being considered as an attractive proposition by PTTs both financially and technologically. Nick Medlam, Managing Director of Focom Systems International, and John Harrison examine its advantages 162

CONTENTS

Power Line Carrier Systems for Developing Countries

Integrated system evaluations of power lines can take much of the guesswork out of power line carrier installations. Tomas A Blet, Applications Engineer for Westinghouse Electric Corporation, explains the groundwork necessary for the successful installation of a multi-channel telephone carrier system 168

Intercoms for Every Environment

Conditions in developing countries can range from extreme temperature changes to dangerous thunderstorms. Dick Parata, General Manager of Barkway Electronics, explains how equipment is designed to cope with all possible hazards 172

Morse Makes a Comeback

With the arrival of satellites and computers, most people consider that morse code is old-fashioned. Bob Surtees, Sales Manager of Morse Equipment Ltd, explains however, that it is still an internationally used method of communication 174

Transportable Radio Systems: Assessing the Advantages

Versatility and cost-effectiveness are major priorities for telecommunications systems in Third World countries. John MacDonald, of the International Marketing Group of Loral TerraCom in California, gives a brief summary of how transportable systems, can match these requirements 176

RURAL COMMUNICATIONS

Appropriate Technology for Rural Telecommunications

In recent years, rural telecommunications have become an area of special concern both for equipment suppliers and for PTTs in developing countries. As the problems common to all remote locations are identified, so manufacturers are responding with an increasingly wide range of solutions. Ann Lloyd, Advertising Manager of SR Telecom Inc, outlines the planning priorities for rural networks 208

Meeting Rural Needs

Rural telecommunications systems often have to contend with extreme climatic and geographic conditions, poor power supply and lack of human resources writes F Leleux, Sales Manager of the Telecommunications Networks Department of Jeumont-Schneider 210

Reaching Rural Communities

Rural areas in developing countries are those worst served by existing telecommunications networks. Peter Jorgensen, Export Consultant for Danish Telecom International A/S, explains why and suggests a solution which combines the latest digital technology with planning for the long-term future 212

Providing a Rural Network

Rural areas of Australia have in the past suffered from poor telecommunications facilities. F A Campbell of Telecom Australia International Limited explains how new technology is coming to the rescue 214

MOBILE COMMUNICATIONS

A New Miracle for Mobile Communications

The most recent technological achievement of the International Maritime Satellite Organisation is the portable mobile radio station. Olof Lundberg, Director General of Inmarsat, reports on the Standard C, and its implications for all aspects of mobile communications 222

CONTENTS

Communications on the Move: Automatic Vehicle Location

In both urban and rural situations, the automatic location of vehicles being co-ordinated by one organisation could save both time and money explains Gary Payne, Product Planning Manager of AVL Systems/Mobile Product Division of Motorola Inc 226

Controlling a Mobile Radio Network

Potential customers for mobile radio systems usually have a very clear idea of how they want to use a network. R Jauch, of Brown Boveri & Co Ltd, summarises the expectations of mobile radio users and describes one network in operation 228

Extending the Scope for Mobile Networks

Traditional mobile radio systems tend to be hampered by coverage limitations, especially where frequencies are overcrowded. P J Delow, Technical Manager of GEC Communication Networks Ltd, describes a shared system, that overcomes these problems 231

DIGITISATION & INFORMATION TECHNOLOGY

Making the Right Choice for a Digital Future

The range of options available for buyers of automated office networks is assessed here by Stewart Muirhead, Marketing Support Manager of STC Telecommunications 256

Integrating LANs and PABXs

Compatibility should always be a high priority in the acquisition of new communications equipment. David Sellings, Marketing Manager of Northern Telecom, explains the merits of combining the functions of two switching systems 258

Digital Signal Processing at Work in the Developing World

Radio systems in remote locations need to be reliable and cost-effective in order to be of any value to a community. Carl S den Brinker, Technical Director of Rediffusion Radio Systems Ltd, explains how digital signal processing can ensure both these qualities 260

Positive Steps Towards ISDN Technology

Business users in developing countries are likely to be the first to benefit from the introduction of the integrated services digital network, or ISDN. Yet its implementation is still a distant dream for most Third World PTTs. Barrington G Lloyd, writer on international communications and consultant to Plessey Telecommunications Ltd, suggests that the use of private ISDN networks could help to bridge the gap 263

Keeping Communications Costs Down

Cost-effectiveness has to be a priority in all forms of communications planning, especially when there are constraints on finance, writes Gosta Linder, Strategic Product Manager of Ericsson Telecom 266

Introducing ISDN

The integrated services digital network or ISDN, promises an innovative future for information technology. Y Kotaka, Vice President of NEC Corporation, describes the different versions of ISDN and explains how they will be put into operation 268

Encouraging the Use of Information Technology

Information technology systems for developing countries are often assessed without real regard for the requirements of users. Riccardo Rietti of Televas SpA outlines an approach which puts the customer first 272

CONTENTS

POWER

Batteries for Back-Up Power

Uninterruptible power supply (UPS) equipment has an essential role to play in many networks, especially in developing countries where the electricity supply can be subject to fluctuations or even fail completely. George Wilson, Consulting Engineer to Chloride Industrial Batteries Ltd, describes the requirements for an efficient UPS standby battery 314

Taking the Risk out of Power Supplies

However sophisticated the technology, the benefits of a modern communications system can still be eradicated by one major problem – lack of power. Lou Welt, Marketing Communications Manager of the International Power Machines Corporation, stresses the importance of power protection equipment for any communications system 316

SATELLITES

Cheaper and Better: The Future for Satellite Communications

The impact of satellite communications has been enormous and often more significant in developing countries than in the industrialised north. But there is clearly much still to achieve. Alistair D Scott, Assistant Sales Manager of British Aerospace PLC, suggests some possible remedies for the future 320

Satellite Services Lead the Way

Despite the enormous potential of global satellite communications, the investment required is often too high. Joseph N Pelton, Director of Policy for Intelsat, describes the programmes initiated and run by Intelsat which are designed to overcome these problems for developing countries 324

Making Satellites Pay their Way

Investment in a satellite system is a major consideration for any country. Yet proper use of new technological advances can ensure profitability. Marianne Lamblot and Daniel Malègue of Aerospatiale at Les Mureaux propose some commercial applications for satellite systems 330

Earth Station Options

Increasingly, satellite communication is becoming the logical choice for countries wanting to set up a coherent domestic communications network. Brian Ackroyd, Assistant Marketing Manager, Space and Broadcast Division of Marconi Communication Systems Ltd, explains the principles behind earth station equipment 332

Options for Satellite TV Distribution

Decisions about how to distribute a television service to a community depend upon the transmission facilities available and the potential costs involved. Louis N Anciaux, President of the Communications and Systems Division of Lunar Industries Inc, considers a range of possibilities for television coverage 336

Ground Rules for Satellite Television

Satellite technology has made it possible to receive television signals in all parts of the world although the reception differs widely. John Donnithorne, Senior Development Engineer in the Space and Broadcast Division of Marconi Communications Ltd, explains why and gives a guide to the size of antenna required in different locations 341

Racing to Get Satellites into the Sky

While the West is having to recuperate from a year of disasters, competition in the satellite launching industry is increasing from the Japanese, Chinese and the Soviet Union. Jonathan Moggridge, Editor of *Communications Engineering International*, explains how this uncertainty is affecting one of the biggest markets for satellite communications – developing countries 346

CONTENTS

BROADCASTING

Towards a Global Network

The idea of a world united by reliable broadcasting links need not seem so remote now that we possess the necessary technology. But the success of such a scheme depends entirely on international co-operation. The Corporate Planning Bureau of Nippon Hoso Kyokai, the Japan Broadcasting Corporation, describes two main areas of co-operation between nations 374

Communicating Information for Future Prosperity

Knowledge is vital for the healthy development of any society. But it cannot be obtained or used without an effective communications network. Dr Larry Soule, of the Rural Services Project in the Solomon Islands, describes the needs of a region whose survival is dependent upon an effective means of information exchange and explains how this could be achieved 378

Effective Rural Radio

Careful audience research and programming is important for the successful operation of a rural broadcasting service. Florida Kweekeh, St Jerome N Davis III and Thomas Snorton of the Liberian Rural Communications Network, explain how they aim to meet the needs of rural communities in Liberia 384

Exchanging News in the South

News broadcasting in developing countries tends to be dominated by international newsfilm agencies limiting direct news exchange between them. Tetsuo Sagara, Senior Officer of News in the Asia-Pacific Broadcasting Union, describes the achievements of the Asiavision News Exchange in combatting this problem 386

Learning by Satellite and Cable

Television has long been used for educational purposes but its potential is far greater now that satellite and cable communications are available. Jim Stevenson, Head of Educational Broadcasting Services and Education Secretary of the British Broadcasting Corporation, suggests how educational broadcasting can make the most of these new opportunities 390

Developments In Distance Learning

The opportunities for sending educational packages to meet the needs of audiences in remote locations are becoming ever greater. If used imaginatively, long-distance teaching aids can both support and extend existing educational structures, as well as taking information to entirely new destinations. David Worlock, a director of Electronic Publishing Services Ltd, is Chairman of the UK Confederation of Information Communication Industries (CICI) Market Development Group which has recently set up a Distance Learning Forum. Here he outlines some advances in distance learning techniques that could be of particular value to developing countries 394

Cultural Unity Through Broadcasting Skills

Realistic practical training, under the supervision of experienced professionals, is the most effective way of acquiring broadcasting skills. John Turtle, Head of the Radio Training Department at the British Broadcasting Corporation, explains the philosophy behind today's training courses 397

Trained Broadcasters – A Vital Resource

Editorial and technical expertise is an essential component for the successful operation and expansion of any broadcasting network writes Dr Peter Holasek, of the Deutsche Gesellschaft fur Technische Zusammenarbeit (GTZ) GmbH 400

Training at Home or Abroad

Once training has been recognised as a priority for a growing broadcasting network in a developing country, the management concerned must make a careful choice of training programme. Reinhard Keune of the Friedrich Ebert Stiftung, in Bonn, considers the options which are available to broadcasting managements 402

CONTENTS

A System to Serve a Nation

Making a choice of transmission method for a new satellite broadcasting service is a complicated task. G E Moriarty, Director of Engineering and Property for the Australian Broadcasting Corporation, reports on how the decision to use B-MAC was made 406

New Trends in Transmitters

The worldwide demand for broadcasting transmitters is as great as ever, despite the advent of alternative forms of broadcasting. Ian Waters, Product Manager for Transmission Equipment at Pye TVT, looks at the technology now on offer 409

Solar-powered Television Transmission

M M Asthana, Chief Engineer of Doordarshan of India, explains how they have overcome the difficulties of maintaining both equipment and a reliable power supply with some very adaptable and economic technology 412

Communications Structures: Specifying the Best Design

The structures that support the equipment for any communications network are themselves crucial to its efficient operation. Don Marshall, Vice President of Engineering at LeBlanc & Royle Telecom Inc, summarises the factors that must be taken into account at the design stage 416

Basic Tools for a Radio Station

Despite phenomenal advances in communications technology worldwide, there are still small communities that can only be reached by radio. Irfan Ullah, Director of Engineering of the Pakistan Broadcasting Corporation, lists the minimum requirements for a radio station to become operational 419

Choosing Cameras for High Quality Performance

New technology is constantly improving quality at the same time as bringing down prices. Here, Phil Parker describes the latest advances in field cameras 421

Purchasing Guidelines for Broadcasting Equipment

The acquisition of new broadcasting products can be a hazardous business when the purchaser has no access to the equipment. Simeon Bonzon, Broadcasting Operations Chief at the Bureau of Broadcasts in the Philippines, offers some advice 424

Digitising Broadcasting Equipment

In recent years, all aspects of broadcasting equipment have been affected by digitisation. F F P Machon, Manager of Product Marketing at Sony Broadcast Ltd, describes its impact on the industry 428

Designing for Outside Broadcasts

Outside broadcasting facilities play a major role in the broadcasting services of most developing countries in providing relevant and varied programming to their audiences. Stuart N Moorse, of the Technical Sales Department of PESA International Ltd, outlines the planning priorities for outside broadcasting and other mobile units 431

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AUSTRALIAN COMMUNICATIONS EQUIPMENT*

AUSTRALIA has developed communications products that are internationally competitive and responsive to the needs of a highly efficient and developed economy.

Products, techniques and skills have developed to operate telecommunications systems over the country's vast distances reaching remote rural areas and scattered island communities. Australia is a pioneer of efficient communications over long distances. These in turn have been linked to the international community via satellite and undersea cable links.

Today the industry is continuing to adapt the latest technology to meet the exacting demands of vast distances and scattered population.

Australia is a world leader in remote area radio and television satellite reception. Programs are beamed by the satellite network to nearly every part of the country and are received by specially developed dish antennae.

Microwave radio transmitters and repeater stations transmit most of the nation's telephone traffic, and Australian designed and built satellite relay stations are vital telecommunications links in space exploration.

Australian companies and Australian-based subsidiaries supported by some 250 specialist manufacturers form the basis of the nation's telecommunications industry.

The variety of telephone equipment manufactured ranges from new switching based on digital technology to submarine optical fibre systems, PABX and other small business systems, mobile radio telephones, basic and sophisticated telephone handsets, submarine and land line transmission equipment including optic fibre, coaxial and standard cables, and an extensive range of large scale automatic telephone exchange and testing equipment are just some of the items produced by the Australian communications equipment industry.

Australia's capacity in the communications field goes far beyond the telephone landline network. It covers defence and civilian radar, satellite transmission and receiving; radio and television broadcasting equipment (complete studios to antenna); advanced encryption equipment; earplug style radio receiver and transmitter sets for hands free clear communication by airport ground crews, firefighters, factory workers etc; electronic funds transfer systems, modems, multiplexors, facsimile, and computer software systems to support the most modern hardware equipment. Detailed information on companies and their products follows this short introduction to the Australian industry.

Much of the Australian equipment is produced to meet varying international standards. For example, the Commonwealth Scientific and Industrial Research Organisation is involved in the software development and design of a processor for the European resources satellite synthetic aperture radar and is a part of the Australian consortium to design ground stations for Intelsat.

Firms are producing equipment to BELL, CCITT, and other international standards.

Export sales for the industry as a whole totalled $60m in 1986 out of total domestic sales of $1.4bn. Major export markets are USA, United Kingdom, New Zealand, Papua New Guinea, Hong Kong, Fiji, Singapore, Sweden, Malaysia and Indonesia. Sales to the United States comprise about 16% of total exports.

Exported equipment includes telephone exchange equipment, call queue systems, power rectifiers, PABX systems, mobile radios, radio communications equipment, antennae and components, rural radio systems and HF transceivers, repeaters for submarine cables, power supply equipment, PABXs, satellite relay station equipment, EFT/POS terminals, specialist business systems, network monitoring equipment and electronic push button telephone systems.

Australian designed mobile radios and mobile telephone systems have found wide acceptance in many markets. Complete equipment kits, materials, technology and know-how for radio communications are being supplied to China under a four year contract.

Australian built radar equipment is being shipped to the USA for installation in the F/A-18 fighter attack aircraft which Australia is buying from McDonnell Douglas.

Electronic funds transfer and encryption equipment is in use in European and USA banking and credit card systems; power recti-

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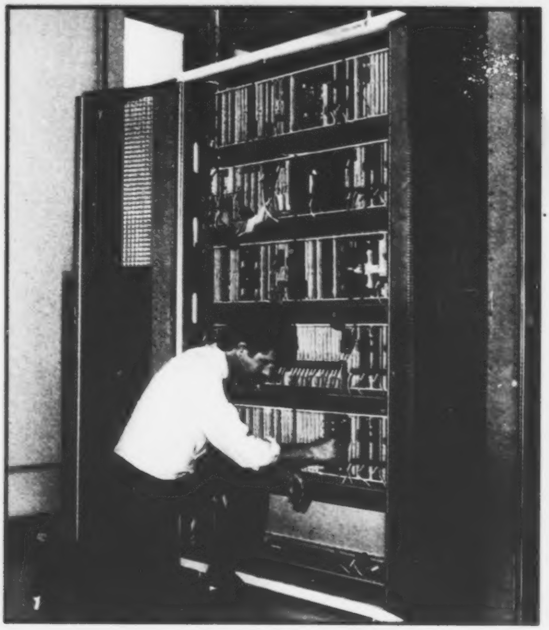
* *This article has been sponsored by the Australian Trade Commission and the Communications Equipment Industry Strategy Coordinating Committee (CEISCC).*



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1. AXE rural exchange systems, developed in Australia as an Ericsson-Telecom joint venture, have been exported to Fiji and Tonga.

2. Ericsson's ASDP 162 automatic call distribution system has been exported to 14 countries.

3. Satellite systems and equipment have been supplied to the USA's Hughes Aircraft Corporation by STC. Shown is a technician inspecting soldered joints of a component.

4. Advanced components and systems for world markets stem from AWA's up-to-date design facilities for integrated custom circuits.

5. Australian antenna system technology is being supplied to world markets from Andrew Antenna's Australian operation.

6. Strict quality control in the production of circuit boards enhances the export potential of products supplied by J.N. Almgren.

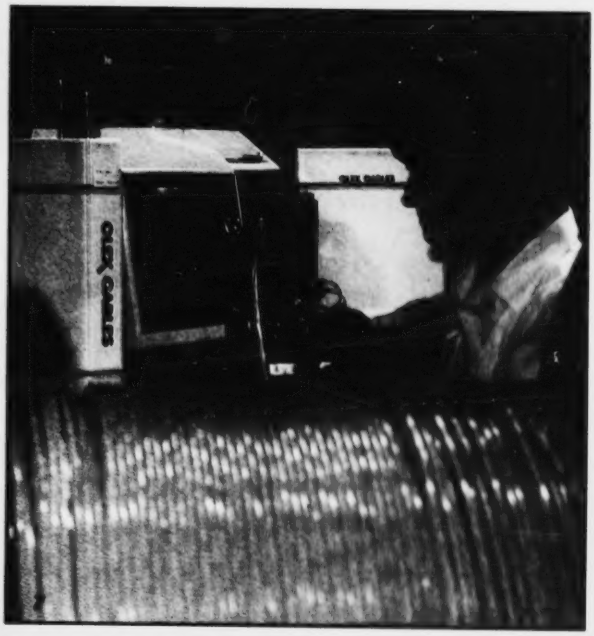
5

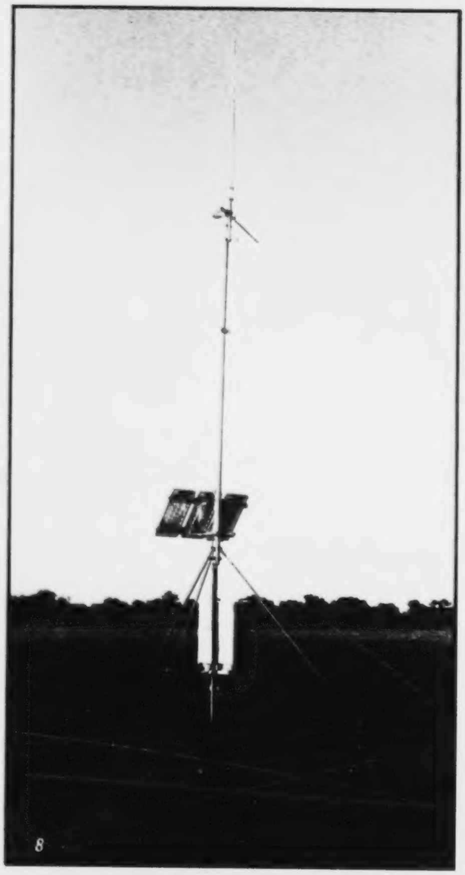
3

4

7. Olex communications cables are winning sales in Europe and the Pacific. Characteristics of a cable are pictured being confirmed through an optical time domain reflector instrument.

8. NEC in-field digital radio concentrator systems are being actively promoted in China in association with Telecom.

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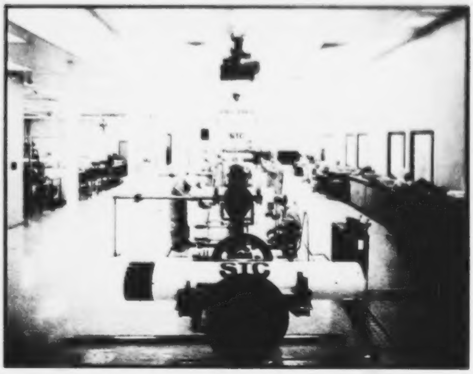
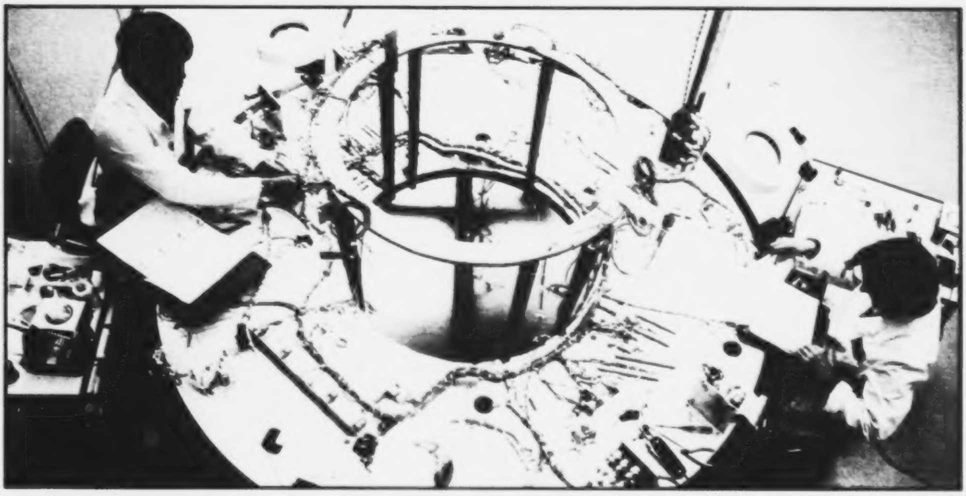


Cleanroom STC Liverpool Submarine cable manufacture.

Australia's high technology industry is well established at J N Almgren.



Complex wiring harness assemblies for satellites produced to rigorous specifications in the STC factory, Liverpool.

Hypercom's NAC16 network access controller is a powerful and flexible multichannel data communications interface unit designed to interface EFT POS terminals to high performance networks such as X.25 or SNA.

fiers have been supplied to Hong Kong telephone exchanges and other orders are expected to follow. These are but a few examples of Australia's international competitiveness resulting from the application of the latest technology and production methods.

The Australian communications equipment industry is well placed to enter into joint venture opportunities with overseas firms. The industry and the Australian economy are equipped with a number of intrinsic strengths which make it attractive for overseas firms to enter into joint venture arrangements. These include:–

☐ a sophisticated communications infrastructure which provides world class opportunites to develop and test new products; for instance by the end of 1988 Australia will have a national ISDN capability; substantial expertise in optical trunk links, a dedicated EFT/POS network, integrated satellite links, extensive rural digital networks, cellular radio and network management systems

☐ well developed engineering and systems skills in public communications agencies, research authorities and tertiary institutions

☐ world class flexible manufacturing, design and test facilities

☐ a growing pool of small, entrepreneurial, highly skilled firms entering the industry

☐ a competitive edge in the development of rural and remote communications markets

☐ attractive financial, fiscal and investment incentives geared towards exported products.

The dynamic research environment is supported by the Australian Tertiary Institutions Consulting Companies Association (ATTICA), a network of 50 units based in universities, institutes and colleges throughout Australia, New Zealand and South East Asia. Specialist skills are available across a wide range of technology areas.

Future Directions

In recognition of the growth occurring in both the Australian and international marketplace industry, Australia's industry, unions, and Federal and State Governments have developed a strategy framework to harness the various industry strengths. This will complement more general industry development and export initiatives by a process of co-ordination of public and private resources. The Australian industry fully expects that a combined commitment to this strategy will result in a quantum leap in the wide range of Australian products already available in international markets. ☐

L.T. MacAlister
Managing Director
Australian Trade Commission

T. Johnson
Chairman
Communications
Equipment Industry
Strategy
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Contact: Mr Bob Clemesha
Managing Director

☐ Antenna systems – concentrates solely on large dish market
☐ Communications systems with microwave components (engineering)

MORRIS PRODUCTIONS (SALES) PTY LTD
2-12 Harp Street (PO Box 175)
CAMPSIE NSW 2194
Tel: (02) 789 6200. Tlx: AA26229
Contact: Mr R J Gibson
Group Managing Director

☐ PCB's

NESS SECURITY PRODUCTS PTY LTD
17 Rowood Road
PROSPECT NSW 2148
Tel: (02) 631 5111
Contact: Mr Naz Circosta
Director

☐ Security alarm products

NETCOMM (AUSTRALIA) PTY LTD
Unit B, 25 Paul Street North
NORTH RYDE NSW 2113
(PO Box 284, PYMBLE NSW 2073)
Tel: (02) 888 5533. Tlx: AA 27113
Contact: Mr Chris Howells
Manager

☐ Modems

PHILIPS INDUSTRIES HOLDINGS LTD
15 Blue Street (PO Box 1139)
NORTH SYDNEY NSW 2060
Tel: (02) 925 3333. Tlx: AA20165
Contact: Mr J Boettcher
Export Manager

☐ Transceiver (hybrid circuit design) & selected call facilities
☐ Traffic control systems, modems, PABX, sonar equip, marine & mobile transceivers

PLESSEY PACIFIC PTY LTD
122 Arthur Street
NORTH SYDNEY NSW 2060
Tel: (02) 9298299
Contact: Mr V N Cramer
Administrative Services Executive

☐ Telecommunications equip (inc. line carrier equip, handsets, switchboards PAX and PABX main exchange & ancillary equip)

POWER ELECTRONICS
7/9 Averill Street
RHODES NSW 2138
Tel: (02) 7363566. Tlx: AA25178
Fax: (02) 733668

☐ Power equipt for telephones
☐ Plating rectifiers
☐ Tractron supplies
☐ UPS for comp equipt
☐ AC/DC motors with variable speed drives

PRINTRONICS LTD
25/33 College Street
GLADESVILLE NSW 2112
(PO Box 389, RYDE NSW 2111)
Tel: (02) 816 5066. Tlx: AA 22965
Contact: Mr M F Brinsden
Director/General Manager

☐ PCB's

RADIO TRANSMISSION ENGINEERING PTY LTD
179 Military Road
GUILFORD NSW 2161
Tel: (02) 6812488. Tlx: AA170664
Contact: Mr R E Rumble
Executive Chairman

☐ Radio transmitters

RACAL ELECTRONICS PTY LTD
(Radio Communications Division)
47 Talavera Road
NORTH RYDE NSW 2113
Tel: (02) 888 64444. Tlx: AA20365
Contact: Mr B E Briggs
Director-in-Charge

☐ Radio communications – HF, VHF, UHF, & masts

AUSTRALIAN COMMUNICATIONS EQUIPMENT

RF INDUSTRIES PTY LTD
66 Smith Street
MARRICKVILLE NSW 2204
Tel: (02) 519 5188
Contact: Mr Steven Jacques
General Manager

☐ Communications antenna for base station and mobile for 2-way radios

SCITEC COMMUNICATION SYSTEMS LTD
3 Apollo Place
GPO Box 625
LANE COVE NSW 2066
Tel: (02) 4289555. Tlx: AA21730
Contact: Mr Moshe Yerushalmy
Managing Director

☐ Modems – range, statistical & high speed time division multiplexors

STANDARD COMMUNICATIONS PTY LTD
6 Frank Street (PO Box 296)
GLADESVILLE NSW 2111
Tel: (02) 816 4755. Tlx: AA26827
Fax: (02) 8162198
Contact: Mr A W Stehr
Group General Manager

☐ Radio-broadcast receivers
☐ Telephone equipment
☐ Radio transceivers and transmitters

STANDARD TELEPHONES AND CABLES PTY LTD (STC)
280 Botany Road
ALEXANDRIA NSW 2015
(GPO box 525, SYDNEY NSW 2001)
Tel: (02) 699 0044. Tlx: AA20208
Contact: Mr Gerald York
Manager
Exports, Defence, Offsets

☐ PCB assembly, switching, trunk exchange & transmission equip, modems & multiplexors, satellite equip, defence projects, telephone handsets, small business systems & recitifier equipment
☐ Pulse code modulation equipment

TBC PTY LTD
(See Radio Transmission Engineering Pty Ltd)

☐ Radio transmitters

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301 Castlereagh Street
SYDNEY NSW 2000
(PO Box 402 HAYMARKET)
Tel: (02) 2177600. Tlx: AA123451
Contact: Mr J D Jackson
Company Secretary

☐ Radar equipment

TYTEL PTY LTD
74 Whiting Street
ARTARMON NSW 2064
Tel: (02) 698 5577. Tlx: AA75487
Contact: Mr C Tyree
Managing Director

☐ Executive telephone system
☐ Secretarial answering station

UTILUX PTY LTD
14 Commercial Road (PO Box 68)
KINGSGROVE NSW 2208
Tel: (02) 50 0155. Tlx: 121516
Contact: Mr P Janssen
Managing Director

☐ PCB's

WORMALD COMMUNICATIONS
51 Denison Street
HAMILTON NSW 2303
Tel: (049) 691999
Contact: Mr Don Searle
General Manager

☐ Telephone line equipment, microdialler monitor syst.
☐ Telecommunications equip

WORMALD INTERNATIONAL AUSTRALIA P/L
Corner Ernest & Alexander Streets
CROWS NEST NSW
(GPO Box 1578, SYDNEY NSW 2001)
Tel: (02) 439 6999. Tlx: AA20387
Contact: Mr R C Horne
Export Manager

☐ Controls & controlling equip

VICTORIA

ANDREW ANTENNAS
153 Barry Road
CAMBELLFIELD VIC 3061
Tel: (03) 359 2322. Tlx: AA30840
Contact: Mr J E Macey
Marketing Manager

☐ Antennas – microwave, parabolic, satellite earth station grid & mesh
☐ Troppo scaler

ANTENNA ENGINEERING AUSTRALIA P/L
Garden Street
KILSYTH VIC 3137
(PO Box 191, CROYDON VIC 3136)
Tel: (03) 728 1777. Tlx: AA32274
Contact: Mr D A Cameron
Managing Director

☐ Antenna – HF, VHF & UHF
☐ Radio aerial systems & broadcasting equip

DATA CABLE PTY LTD
538 Mountain Highway
BAYSWATER VIC 3153
Tel: (03) 729 0044. Tlx: AA35834
Fax: (03) 729 1900
Contact: Mr Len Beel
General Manager

☐ Hi-tech assemblies – wire & fibre optics
☐ Electronic components, duplex optic modem FO-232

DATACRAFT (AUSTRALASIA) PTY LTD
Maroondah Highway (PO Box 353)
CROYDON VIC 3136
Tel: (03) 726 9911. Tlx: AA34278
Contact: Mr Colin Weedon
Production Manager

☐ Modems, multiplexors, data concentrators, diagnostic & networking products

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PO Box 20
UPPER FERNTREE GULLY VIC 3156
Tel: (03) 7585933. Tlx: AA31954
Contact: Mr Peter Hall
General Manager

☐ Telephone Apparatus Measuring System

17

AUSTRALIAN COMMUNICATIONS EQUIPMENT

IEI (AUSTRALIA) PTY LTD
15-17 Normanby Road
CLAYTON VIC 3168
Tel: (03) 544 8411. Tlx: AA35780
Fax: (03) 5448648
Contact: Mr M T Cole
Managing Director

☐ Detection systems & electronic security systems

JACOBS RADIO (AUSTRALIA) PTY LTD
3/4 Clare Street
BAYSWATER VIC 3153
Tel: (03) 720 3994. Tlx: AA36310
Contact: Mr M W Jacobs
Managing Director

☐ Microwave assemblies, data links, PCM test equip, system power supplies
☐ Digital microwave equip

LABTAM INTERNATIONAL PTY LTD
43 Malcolm Road
BRAESIDE VIC 3195
Tel: (03) 587 1444
Contact: Mr Heimo Eberhardt
Managing Director

☐ Multiprocessor system

L M ERICSSON PTY LTD
61 Riggall Street
(PO Box 41)
BROADMEADOWS VIC 3047
Tel: (03) 301 1299. Tlx: AA30555
Contact: Mr K B Casey
Manager – Export Division

☐ PCB's, components testing, wiring & assembly
☐ Gate array design VLSI
☐ Telecommunications equip

NEC AUSTRALIA PTY LTD
649-655 Springvale Road
MULGRAVE VIC 3170
(PO Box 316, SPRINGVALE VIC 3171)
Tel: (03) 566 6555. Tlx: AA31009
Contact: Mr M Shimofuku
General Manager – Marketing

☐ Telecommunications equip – line carriers, exchange equip, data modems, moible radio telephone systems, radio control & microwave equip
☐ Digital radio concentrator system

OLEX LTD
207 Sunshine Road
TOTTENHAM VIC 3012
(PO Box 33, WEST FOOTSCRAY VIC 3012)
Tel: (03) 316 2222. Tlx: AA30498
Contact: Mr David McNamara
Export Sales Manager

☐ Cables – coaxial, optical fibre, shipwiring & welding

OPTICAL WAVEGUIDES AUSTRALIA PTY LTD
Lot 25, Summit Road (PO Box 436)
NOBLE PARK VIC 3174
Tel: (03) 795 7255. Tlx: AA34984
Contact: Mr R R Lloyd
General Manager

☐ Optical fibre and cable

OPTIX AUSTRALIA LTD
207 Sunshine Road
TOTTENHAM VIC 3012
(PO Box 33 WEST FOOTSCRAY)
Tel: (03) 316 2222. Fax: 3145170
Contact: Mr Peter Long
Manager

☐ Optical fibre & cable
☐ Teleprinters

SEPAC INDUSTRIES (AUST) PTY LTD
134 Beach Street
FRANKSTON VIC 3199
Tel: (03) 7851111. Tlx: AA38691
Fax: 7851818
Contact: Mr Robin Chapple
Export Manager

☐ Selective calling equip
☐ PCB's
☐ Radio telephonic equip

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Contact: Mr T F Korbel
General Manager
Telecommunications

☐ Carrier multiplex equip – inc. translating supply & monitoring equip
☐ Telecommunications equip – inc. line carrier equip exchange equip, PABX's, switchboards

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Tel: (03) 5551566. Tlx: AA30877
Fax: 5533801
Contact: Mr Graeme Eime
National Marketing Manager

☐ Sophisticated multi-electrical connector, microprocessing control systems, Looms/harnessing
☐ Eurocard packaging equip

VALET CORPORATION PTY LTD
750 Springvale Road
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Tel: (03) 561 3722. Tlx: AA36870
Contact: Mr Peter Hanson
Managing Director

☐ Intercom system (domestic)

VICOM INTERNATIONAL PTY LTD
57 City Road (PO Box 366)
SOUTH MELBOURNE VIC 3205
Tel: (03) 6909399. Tlx: AA36935
Fax: 6993239
Contact: Mrs Robyn Kelly

☐ Radiotransceivers, FM transmitters, TV translators, test equip for amateur ('ham') radio

WESTINGHOUSE BRAKE AND SIGNAL CO (AUSTRALIA) LTD
49 Wellington Street (PO Box 87)
ST KILDA WEST VIC 3182
Tel: (03) 529 7666. Tlx: AA30966
Contact: Mr H R Grant
Managing Director

☐ Controls & controlling equipment – inc. railway track control systems

SOUTH AUSTRALIA

BRITISH AEROSPACE AUSTRALIA LTD
Salisbury Road (PO Box 180)
SALISBURY SA 5108
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Contact: Mr A Waugh
Technical Director

☐ Navigational aids, optoelectronics & Aircraft Fatigue Data Analysis System (AFDAS)

CODAN PTY LTD
Graves Street
NEWTON SA 5074
(PO Box 96, CAMBELLTOWN SA 5074)
Tel: (08) 336 0311. Tlx: AA88155
Contact: Mr M R Ralph
Marketing Engineer

☐ HF radio communications systems

FAIREY AUSTRALASIA PTY LTD
2-6 Ardtornish Street
HOLDEN HILL SA 5088
(PO Box 71, ST AGNES SA 5097)
Tel: (08) 266 0666. Tlx: AA89029
Contact: Mr J F Baker
Operations General Manager

☐ Radar systems & optoelectronic devices

HILLS INDUSTRIES LTD
944-956 South Road
EDWARDSTOWN SA 5039
Tel: (08) 297 3888. Tlx: AA82110
Contact: Mr E T Ward
Managing Director

☐ Microwave components & sub-assemblies
☐ Antennas, radio aerial system & frequency amplifiers

TEKNIS LIMITED
Philips Crescent
HENDON SA 5014
(PO Box 54, ALBERTSON SA 5014)
Tel: (08) 286 6122. Tlx: AA88841
Fax: (08) 268 6487
Contact: Mr Rod Peirce
National Marketing Manager

☐ Microprocessor-controlled supervisory equipment
☐ Remote control systems – TRCS 16-32 family
☐ Telemetry systems

VISION SYSTEMS PTY LTD
Innovative House West
Technology Park
ADELAIDE SA 5095
Tel: (08) 349 5988. Tlx: AA87587
Contact: Mr Andrew Gitsham
Managing Director

☐ Surveillance systems

WESTERN AUSTRALIA

CIRCUIT TECHNOLOGY AUSTRALIA PTY LTD
16 Yampi Way (PO Box 215)
WILLETTON WA 6155
Tel: (09) 457 6388. Tlx: AA93716
Contact: Mr M A Lynch
General Manager – Sales

☐ PCB's

MAGELLAN CORPORATION (AUSTRALIA) P/L
248 St George's Terrace
PERTH WA 6000
(PO Box 7188, Cloister's Square
PERTH WA 6000)
Tel: (09) 322 1043. Tlx: AA92195
Contact: Mr R Lewis
Director

☐ PCB's & electro-mechanical manufacture

RAN DATA PTY LTD
5th Floor, 297 Murray Street
(PO Box F336)
PERTH WA 6000
Tel: (09) 321 8844. Tlx: AA92518
Contact: Mr M Sala
Managing Director

☐ Data encryption systems
☐ Specialised PROM burners
☐ Modem eliminators

COMSYS AUSTRALIA PTY LTD
360 Rokeby Road
SUBIACO WA 6008
Tel: (09) 3817877. Tlx: AA93173
Contact: Matt Saunders

☐ A.T.S.S. 1000 software package
☐ Automated testing for broadband telecommunication links

RADTEK CORPORATION LTD
18 Prowse Street
WEST PERTH WA 6005
Tel: (09) 322 4955. Tlx: AA93960
Contact: Victor Leonzini
Managing Director

☐ DL 800 Autoprint
☐ Mobile Data Terminals and Radio Modems

AUSTRALIAN CAPITAL TERRITORY (ACT)

AUSTRALIAN OPTICAL FIBRE (RESEARCH) PTY/LTD
9 Lyell Street
FYSHWICK ACT 2609
Tel: (062) 805 911
Contact: Mr Graham Cole
Commercial Manager

☐ R&D facility – prototype optical fibre sensors, components & sensor systems

ORTEX AUSTRALIA PTY LTD
Unit 3, Centre Court
FYSHWICK ACT 2609
Tel: (062) 805283. Tlx: AA62043
Contact: Mr Bob Trewin
Executive Director

☐ Communications software
☐ Minicomputer system

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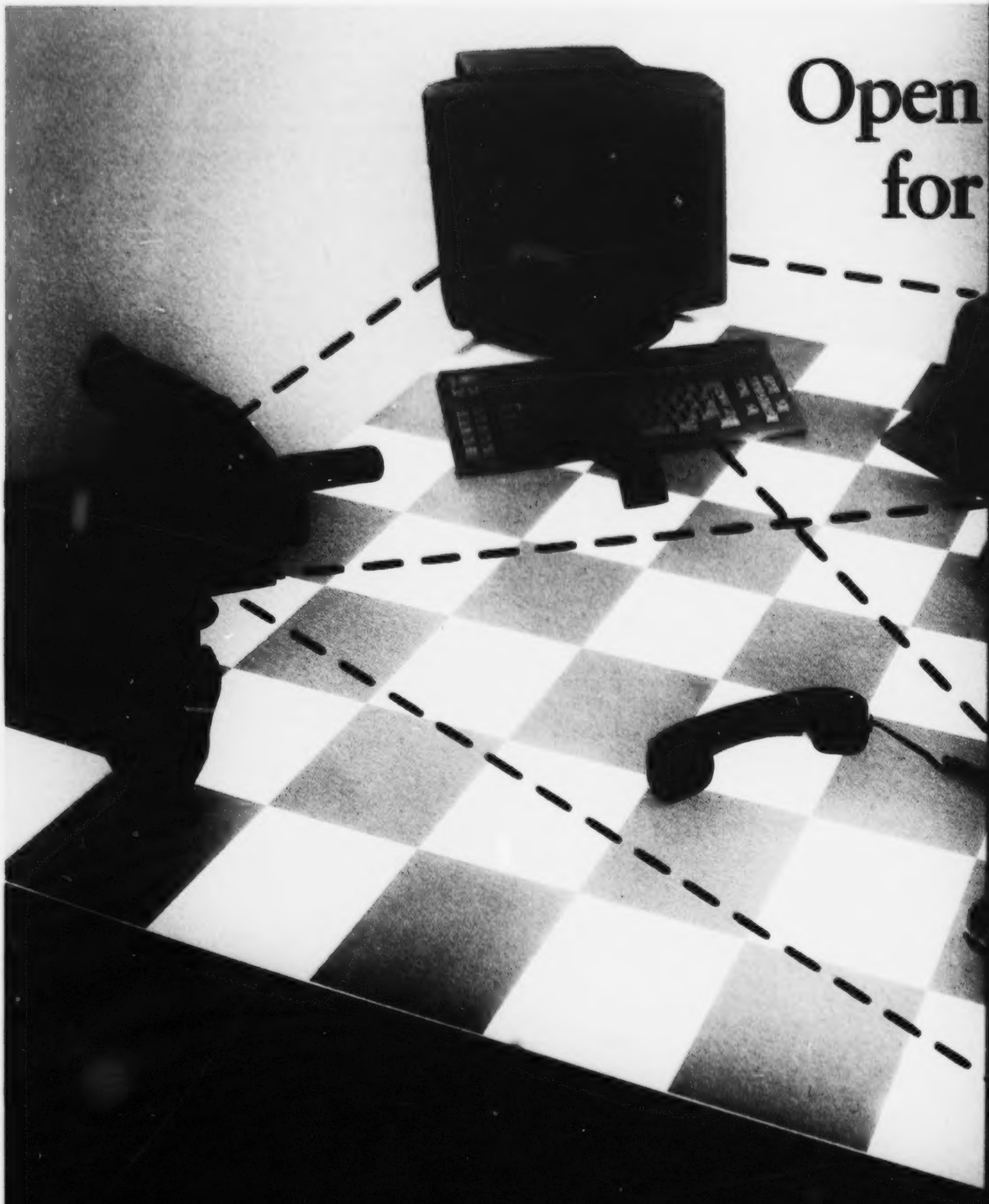

networks
the world.

People have one basic need — to be able to communicate how they please, when they please, where they please. Which is precisely where Ericsson comes in: our business mission is to allow them to do just that.

That's why we develop products that can handle and transmit voice, text, data and image.

We combine these products to form systems which make up integrated networks to solve problems in both public and private telecommunications. And we supply such advanced electronic defence systems as complete communications networks, command systems, mobile radar systems and airborne systems.

PUBLIC TELECOMMUNICATIONS

Here, our digital switching system, AXE, is the most successful telecommunications system the world has ever seen, installed in fixed networks in more countries than any other system. It's at the heart of Ericsson's system for cellular mobile telephone networks — which is also the unquestioned world leader. Supported by the world's widest software library, and by proven tools and aids for network design, and taking into account our leading position in fibre optics technology, and in the production of cables and components, AXE has made Ericsson one of the largest and most capable manufacturers in the world.

PRIVATE BUSINESS COMMUNICATIONS

The private equivalent of AXE is the MD 110 PABX. As a key node in private networks, MD 110 can be supplied free-standing or as part of a turnkey project. It allows full integration with public networks based on AXE, to provide an advanced network handling every aspect of business communications.

DEVELOPMENT FOR THE FUTURE

Ericsson has over 72,000 people world-wide, and allocates a figure equivalent to nearly 10% of its sales revenue to research and development. Leaders in fibre optics and optical technology, pace-makers in systems for business, advanced in the development of the Integrated Services Digital Network, future-proof in the open-ended architecture of its network systems, Ericsson has an assured place in the future of telecommunications.

FIGURES

Ericsson operates through some 180 subsidiary or associated companies in over 90 countries world-wide, with extensive local manufacture and management. Only 22% of all sales are to the Swedish market.

For further information about the Ericsson Group, please call or write to the address below.

ERICSSON

Telefonaktiebolaget LM Ericsson,
Corporate Relations,
S-126 25 Stockholm,
Phone +46 8 719 00 00

Ericsson Business Areas

Public Telecommunications

Ericsson is among the world's four largest manufacturers of telephone exchanges for public networks. The product programme also includes a full range of transmission systems, telex and data-handling systems, and systems for such services as videotex, teletex, and cable TV.

With nearly 17 million lines installed or on order across more than 60 countries, AXE is by far the world's most widely installed digital switching system.

Field trials or commercial operations in ISDN and enhanced Centrex are gaining rapid acceptance for Ericsson systems in these areas. Ericsson is particularly strong in the area of business communications, entirely within the public switched domain or integrated with private systems.

Information Systems

Information Systems is responsible for Ericsson's products and systems in the handling of information in private networks.

The line of products and systems is very broad, ranging from portable PCs to advanced systems for distributed data processing and voice transmission, in which the MD 110 PABX is the key product.

It includes a wide variety of special-purpose work-stations, business systems, telephones and other terminals.

A particular strength is custom-tailored information-handling systems for banks and other financial institutions.

Radio Communications

Ericsson is the world's leading supplier in the expanding market for cellular mobile telephony, with more than 40% of the total world market.

It delivers completely integrated systems comprising mobile stations, base stations and switching equipment. Ericsson was the major contractor for the world's largest cellular network — the Nordic Mobile Telephone network, with over 700,000 lines installed or on order. Ericsson is now installing a 900 MHz system to provide increased capacity. Ericsson also has 40% of the US market, and is supplying mobile systems to every continent, handling all four major standards.

Defence Systems

For many years, Ericsson has been a supplier of advanced defence products and systems. Supplying a range of command, control and communications and information systems, with particular strength in target-sensing systems and turnkey projects for full defence networks and operational centres, Ericsson defence experience is a valuable asset in the development of advanced commercial products — and extends into space technology: telecommunications equipment is being developed and manufactured for both satellites and ground stations within the framework of international space projects.

Network Construction and Engineering

With expertise in outside-plant networks, in-house telecommunications, security systems, industrial telecommunications and railway signalling, Ericsson is one of the few companies with the international experience and resources to take responsibility for large-scale, tailor-made, turnkey projects.

Cables

Ericsson has for a long time been one of the world's largest manufacturers of power and telecommunications cables.

More recently, Ericsson has become a leader in systems incorporating fibre optics cable. Fibre is increasingly used as an alternative to copper in every telecommunications application, and Ericsson has a range of successful handling systems to smooth installation and maintenance — as well, of course, as the switching and data-processing capability to handle the enormous bandwidths typical of optical fibre.

Components

Strategically important to Ericsson, and the driving force of much of the rapid innovation in telecommunications, components technology is crucial to Ericsson. Through its RIFA subsidiary, Ericsson is the largest manufacturer of electronic components in Scandinavia. The breadth of expertise is necessarily very great, taking in telecommunications power systems, application-specific ICs and hybrids, and components for fibre optics, as well as advanced capacitors and standard components.

Major Products and Systems from Ericsson

AXE

The AXE switching system was developed in conjunction with the Swedish Telecommunications Administration to provide a very high degree of reliability, simplified operation and maintenance, and efficient software.

It is built up from modules of hardware and software based on system functions, each module having standard interfaces with other modules. This functional modularity allows functions to be added, eliminated or changed, and maintenance to be carried out, without disturbing other parts of the system. It also makes it easy to introduce new technologies, so that AXE can be regarded as a truly future-proof system.

A new small AXE, recently developed by Ericsson and Telecom Australia, allows Administrations to provide the benefits of autonomous SPC digital switching at very small exchange sizes. Designed to be competitive in sizes from 40 lines, the system can be extended in increments of eight subscriber lines to a maximum of 2048 lines. The system interworks with either analogue or digital transmission, and is therefore ideal as a small local exchange in rural, suburban or even urban networks, as well as in all phases of the transition to an integrated digital network (IDN). The system can be made compatible with the larger AXE system, which is used to provide local exchanges of up to 200,000 lines, allowing the ready introduction of new facilities developed for the larger system if required.

AXE can now meet the specific requirements of metropolitan, rural and international traffic, and of data, cellular and Integrated Services Digital Networks.

Fibre Optics

Ericsson covers the entire field of fibre optics, from components to turnkey projects, including advanced splicing equipment and, early in 1986, the world's most advanced optical switch.

Light in weight, with minimal space requirements, and inexpensive to lay, optical cable can carry signals of all types, and is competitive in price in a number of cable TV and data communications systems applications, as well as in telephony.

MD 110

MD 110 is a digital communications system for speech and data in private networks. It offers more than 20,000 ports for connecting lines, trunks and data-processing equipment. Basically configured for use as a Private Automatic Branch Exchange (PABX), MD 110 is also used for simultaneous transmission of speech and data in geographically dispersed environments, trunk/tandem switching, earth station/satellite communications, integrated offices and text transmission. It offers intercom facilities, automatic call-back, call-forwarding, call-monitoring and other services.

Business Communications

A feature of modern telecommunications is the increasing demand from business subscribers for advanced services.

The Information Systems business area has achieved a leading position in the supply of intra-organisation systems, helping business subscribers to buy, install and operate networks varying from simple, single-site environments to multi-site set-ups incorporating advanced terminal and optical-fibre facilities.

For public-network providers, the Public Telecommunications business area offers a range of software add-ons which can be implanted in an AXE exchange to provide Centrex services, digital leased lines and virtual private networks, often under subscriber control.

Cooperation between business areas is close, and the concept of the integrated public/private network, based on a single network architecture, is firmly in place within Ericsson.

Cellular Radio

The Ericsson cellular radio system, which is based on AXE technology, makes it possible to converse with subscribers throughout the world while they are in a moving vehicle — without a break in the connection. When a vehicle moves beyond the range of one base transmitter, another picks up and transmits the signal automatically.

BellSouth is your best connection to the information age.

BellSouth International has the expertise and the experience to match a world of telecommunications needs. From building complete networks to designing highly specialized applications of sophisticated technology.

The BellSouth telephone operating area in the Southeastern U.S. confronts us with a variety of environments, from densely populated cities to remote rural areas in a wide range of climate and geography.

During the era of the Bell System, it was the BellSouth area that became the American test ground for technological trials and creative applications. As a result, BellSouth leads the U.S. telecommunications industry in the amount of fiber optic cable installed, providing a technologically advanced network second to none.

BellSouth creates solutions that meet the telecommunications needs of the world. And we are committed to share this expertise. To lead people on every continent into the Information Age.

We're ready to show you how we can put our experience to work for you. Call or write us for more information. BellSouth International Inc., 675 West Peachtree St., N.E., Atlanta, GA 30375 USA. Telex: 543111.

BellSouth International

A BELL SOUTH Company

Your best connection.℠

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BellSouth International brings advanced technologies to the world.

"With the world's economic and political structure so characterized by interdependence, it has become in the best interest of all nations—both developed and developing—to ensure that the benefits of modern telecommunications systems are extended internationally," Mylle H. Bell, president of BellSouth International, said. "If not, many of their potential benefits will never come to pass."

Committed to bringing the most advanced technologies to the international marketplace, BellSouth Corporation, one of the world's largest telecommunications companies, formed an international subsidiary to market BellSouth products and services in telecommunication markets around the world.

"Communications is now recognized as a key ingredient to the establishment and development of an industrialized economy," Ms. Bell said. "To be a major player in an industry that is on the threshold of significant growth, BellSouth felt it was not only necessary but vital that it extend its business boundaries geographically."

One of the largest corporations in the U.S.

Founded July 1, 1985, BellSouth International draws on the telecommunications expertise and products of BellSouth Corporation. As part of the former Bell System prior to its divestiture in 1984, BellSouth is the largest of all U.S. companies providing basic telephone service, with more than $25 billion in assets. Headquartered in Atlanta, Georgia, the international company will concentrate totally on opportunities outside the continental United States.

Initially, BellSouth International is concentrating on markets in Western Europe, Latin America and the Pacific Basin. BellSouth International Asia/Pacific, one of the first overseas offices to open, is based in Hong Kong. BellSouth said it chose this site for several reasons, including its geographical proximity to several lucrative telecommunications markets, its economic and political stability, and its infrastructure and labor force.

One of BellSouth International's first forays into the international marketplace was through its sponsorship of the "China/U.S. Telecommunications Conference" held in Beijing in the fall of 1985. The U.S. Department of Commerce called it the largest conference of its kind ever held in China and one of the most important in the world.

"Our strategy for diversifying is to seek new market opportunities within the rapidly growing information industry, or closely related areas, in which we can apply our technological and managerial expertise," Ms. Bell said. "We are in an age in which the single most important strategic resource will be, simply, information—data, knowledge and ideas."

One of the most technologically advanced networks.

BellSouth's U.S. operating territory has been a major site for trial applications and creative new uses of telecommunications resources and technologies. Its telecommunications network, covering nearly 500,000 square miles of the United States, exemplifies the progressiveness of the company. During the past seven years alone, BellSouth assimilated over $19 billion of new plant investment, which serves nearly 15 million customers, businesses and institutions.

In 1985, BellSouth doubled the amount of fiber optics in its network, with a total of 57,000 miles of optical fiber. This enormous expansion, Bell pointed out, will enable BellSouth customers to receive high-speed data, voice and video services simultaneously on a single telephone line.

"Because the Southeastern United States is growing at such an accelerated pace, BellSouth has one of the most technologically advanced networks in the world," Ms. Bell pointed out. "We bring an exciting mix of telecommunications products and services to the market—from building complete networks to designing highly specialized applications of information technology."

Provider of quality services and products.

BellSouth International offers telecommunications customers around the world a vast array of products and services, including network development, network applications—voice and data, computer-to-computer, specialized networks, cellular radio, fiber optics, microwave systems and cable communications services. The company also provides advertising and publishing; cellular/mobile/paging systems; information systems development—switching, transmission, loop distribution; training and consulting; office systems; and more.

"BellSouth International is prepared to meet the telecommunications demands of the world market," Ms. Bell said. "And we will respond with value-added customer service, dependably and consistently."

BellSouth International

A **BELL**SOUTH Company

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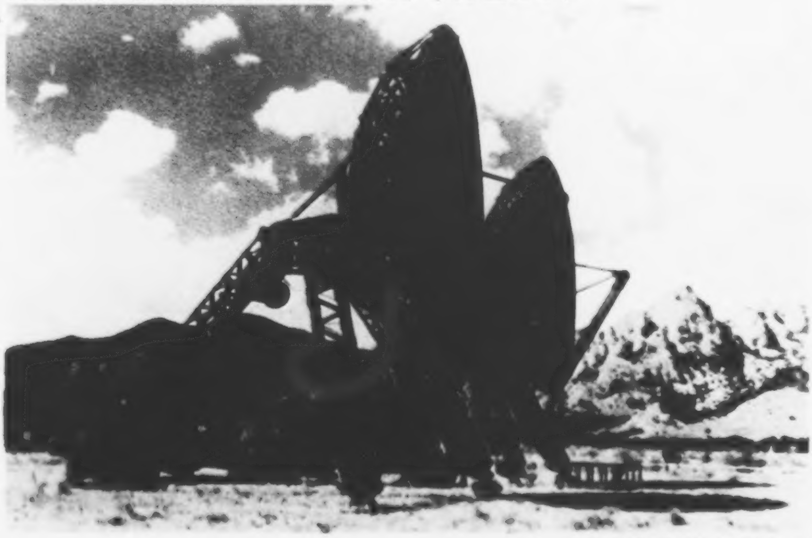
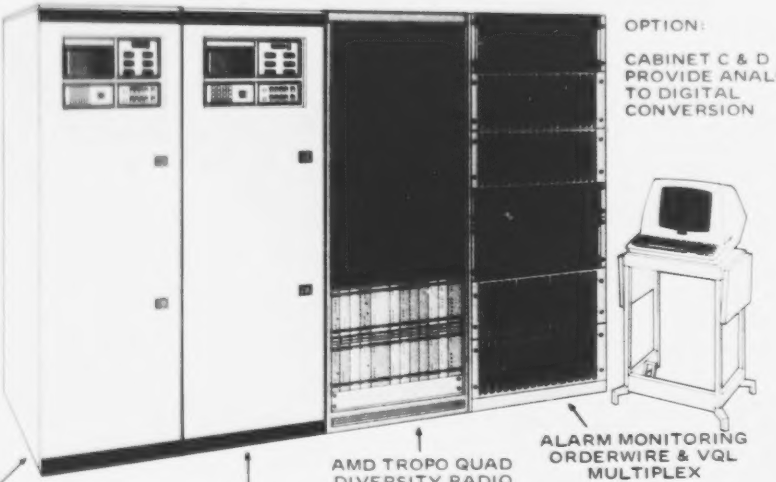
AYDIN CORPORATION (WEST)

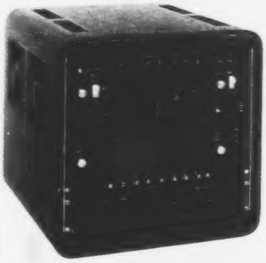


DIGITAL TROPO


HPA'S
MICROPROCESSOR CONTROLLED HPA
A
MICROPROCESSOR CONTROLLED HPA
B
AMD TROPO QUAD DIVERSITY RADIO
C
ALARM MONITORING ORDERWIRE & VQL MULTIPLEX
D

OPTION:

CABINET C & D PROVIDE ANALOG TO DIGITAL CONVERSION



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FOREWORD

by Sir Donald Maitland

In pinpointing the predicament of developing countries in what is fast becoming an information society, Sir Donald Maitland has done much to provoke positive action on behalf of the poorer regions of the world. As Chairman of the Independent Commission for Worldwide Telecommunications Development, whose report 'The Missing Link' has become the byword for anyone concerned with telecommunications for development, his determination that the industrialised world should look beyond its own confines to both the opportunities and dilemmas presented by less developed nations has been infectious. At the heart of the movement towards ensuring that people in all corners of the globe will one day have a telephone within arm's reach and access to information not just for their survival but for their education and entertainment, he is the ideal person to introduce this second edition of *'Developing World Communications'*.

***Above: A symbol for global communications:** Sir Donald Maitland plants a tree at the Arusha meeting held in October 1984 in the presence of the Tanzanian authorities and members of the Independent Commission for Worldwide Telecommunications Development. Photo courtesy of ITU.*

FOR those who live in advanced societies, it is difficult to appreciate that, in much of the developing world, the essential role telecommunications play in economic and social life is not widely understood. The industrialised world takes telecommunications for granted. It feels crippled when, for one reason or another, its telephones are out of order. It is no longer surprised by the advances in micro-electronics and other technologies which offer the ordinary citizen an ever wider choice of new services and which, year on year, bring it closer to the threshold of the so-called 'information society'. Telecommunications is recognised as an industry in its own right, contributing to growth and creating opportunities for future employment. As a business, telecommunications ranks fifth in the United States after energy, transportation, merchandising and real estate. In the United Kingdom one million people provide information services and equipment – the same number as are employed in the financial and construction industries and three times the total engaged in agriculture.

To governments in many developing countries all this seems supremely irrelevant. It is understandable that the most disadvantaged among them, who face intractable problems of hunger, disease, poverty and ignorance, should give high priority to food production, the supply of water, education, public health and roads. For them the telephone is a luxury which the mass of their population cannot afford. Such governments are not alone in their sceptical view of the usefulness of telecommunications; few aid-giving agencies would include telecommunications in any catalogue of basic needs.

When the members of the Independent Commission for Worldwide Telecommunications Development met for the first time in the autumn of 1983, they were confronted with widely differing perceptions of the value of telecommunications. To some extent these matched the striking and quite unacceptable imbalance in the distribution of telecommunications across the world. According to the latest figures available to the International Telecommunication Union (ITU), three-quarters of the 668 million telephones in the world are in eight countries. Developing countries, which account for 70 per cent of the world's population and 20 per cent of world gross domestic product, use 7 per cent of the world's telephones.

It seemed to my colleagues and myself on the Commission that if we were to carry out our mandate 'to recommend a range of methods including novel ones for stimulating telecommunications development in the developing world . . .', we should have to address this question of the role of telecommunications in development at the outset. Neither the time nor the resources available permitted us to undertake any original research. Nonetheless we were able to draw on the copious literature on the subject. This included the study 'Telecommunications for Development' undertaken jointly by the Organisation for Economic Cooperation and Development (OECD) and the ITU in 1983; the 'World Development Telecommunications Report 1980-1990' by Arthur D Little; the conclusions of the three regional seminars organised by the ITU in Costa Rica, Togo and Malaysia during World Communications Year (1983); and the Workshop on 'Communications Technology and Economic Development: a Case Study of Africa' organised by the National Science Foundation and the Agency for International Development in Washington in April 1984. Of particular benefit were the numerous, enlightening and well-documented comments on this issue which we received from governments, international agencies, telecommunications operators, equipment suppliers and many others.

It did not take us long to conclude from these studies and commentaries that, while the benefits in terms of higher revenue which individual small enterprises gained from an efficient telecommunications system could be quantified to the satisfaction of even the most sceptical economist, the benefits available at the national level could not be calculated with the same precision. Nonetheless, it seemed to us that certain conclusions about the role of telecommunications in economic and social progress were beyond doubt. Telecommunications play a vital role in emergency and health services; they increase the efficiency of public administration, commerce and other economic activities; they can reduce the need to travel. The extent to which these activities benefit from the availability of an efficient telecommunications system would of course depend on the efficiency with which each of these is managed; an incompetently run enterprise will not become efficient overnight just because a telephone is installed.

It was also clear that intangible benefits were available. An effective network can contribute to national cohesion, it can enhance the quality of life and it can distribute the benefits of economic, social and cultural development more evenly throughout the community.

We were equally in no doubt about the existence of a correlation between investment in telecommunications and economic growth. But whether investment in telecommunications leads to growth or whether growth stimulates investment was not clear to us. We thought it right, therefore, to frame our opinion on this general issue in terms which we believed were incontestable. Accordingly we concluded that 'henceforward no development programme . . . should be regarded as balanced, properly integrated or likely to be effective unless it includes a full and appropriate role for telecommunications, and accords a corresponding priority to the improvement and expansion of telecommunications'.

In considering what remedies to propose we accepted that telecommunications systems in the developing world would be improved and expanded only if effective action were taken by different people on various fronts. This is why some of our recommendations are addressed to governments of developing countries, others to governments of industrialised countries, international agencies, telecommunications operators and equipment suppliers, and finance houses. These recommendations had four main aims: to ensure that investment in telecommunications was given a higher priority; to make existing networks more effective; to ensure that the financing arrangements took account of the foreign exchange problems of developing countries; and, finally, to improve international cooperation in this field.

One important recommendation calling for immediate action was addressed to the ITU. Representatives of many developing countries had impressed on the Commission the need for high-quality, disinterested advice at the pre-investment stage. The Commission's response was to propose the establishment of a Centre for Telecommunications Development. This would have three components: a Development

***Above:* A solar-powered telecommunications link into the existing network in Botswana: developing countries, which account for 70 per cent of the world's population and 20 per cent of world gross domestic product, use 7 per cent of the world's telephones. Photo courtesy of SR Telecom.**

Policy Unit, which would collate and disseminate information about policies and experience as well as the results of continuing research into the role of telecommunications in economic and social development; a Telecommunications Advisory Service, offering a range of expert advice on creating, managing and operating a telecommunications network; and an Operations Support Group, providing specific practical help as a complement to the work of the Technical Cooperation Department of the ITU.

The report of the Independent Commission, entitled 'The Missing Link', was delivered to the Secretary-General of the ITU in January 1985. At its 40th session the Administrative Council of the ITU endorsed the general thrust of the Commission's conclusions and recommendations. The Secretary-General of the ITU had, however, already taken steps to bring the Commission's report to the attention of those to whom it was addressed. A World Telecommunications Conference was held in Arusha, Tanzania in May 1985. This conference, which was attended by delegates from 93 member countries of the ITU and representatives of many international and regional agencies, examined the Commission's report in detail. The Arusha Declaration of 30 May 1985 broadly endorsed its conclusions and recommendations and urged governments of developing and industrialised countries to take certain specific actions proposed by the Commission. The value of this Conference – the first of its kind in the history of the Union – lay in the opportunity it provided for those, particularly in the developing world, who hold positions of high responsibility in telecommunications to discuss, and therefore better understand, the comprehensive programme for bridging the telecommunications gap which the Commission had advocated and to appreciate the role they themselves might play in the process. An opportunity to renew the debate arose in September 1986 when the first ITU World Telecommunication Forum to be held on African soil took place in Nairobi. The theme of Africa Telecom 86 was 'Bridging the Missing Link'.

The publication by the ITU in February 1986 of 'Information, Telecommunications and Development' further stimulated discussion. This document contains the results of recent detailed research into the role of telecommunications in the socio-economic development of developing countries. A further ITU study 'Investing in Telecommunications', published in July 1986, contains a detailed plan of action which could serve as a guide to governments of developing countries who decide to upgrade and expand their networks.

Others in various parts of the world have been active in promoting discussion of communications and development. Two examples illustrate the wide interest in this subject. In November 1985 the Japan Institute of International Affairs held a symposium in Tokyo to discuss the impact of advanced information and communications technology on economic interdependence between developed and developing countries. At its second annual meeting in March 1986 CANTO – the Caribbean Association of National Telecommunications Organisations – discussed the implications of 'The Missing Link' for their own efforts to improve regional cooperation.

The response of the ITU to the Independent Commission's proposal for a Centre for Telecommunications Development has been swift. In July 1985 the Administrative Council established the Centre broadly on the lines suggested by the Commission. An Advisory Board, representative of both the public and private sectors, was appointed with defined responsibilities for the management of the Centre. In June 1986 Dietrich Westendoerpf, the Managing Director of Detecon, was appointed Executive Director of the Centre; his Deputy is Ahmed Laouyane, who has been a member of the ITU headquarters staff since 1977. These two appointments, the definition by the Advisory Board of the mandate for the Centre and the arrival in Geneva of a number of voluntary contributions from governments, operators and industry enabled the Centre to begin operating in 1986. By normal standards of international organisations this is a notable

Right: *Old and new in China: the fibre optic cable strung across the paddyfields links digital telephone exchanges at either end of the Shenzhen special economic zone. Photo courtesy of Cable & Wireless.*

31

achievement. The members of the Advisory Board are to be commended.

Whether or not it is coincidental, there are signs that the World Bank, the International Finance Corporation and a number of the major operators and equipment suppliers have been showing increased interest in developing world telecommunications. The Japanese, who hosted the economic summit of the seven major industrial nations in Tokyo in May 1986, are known to have been disappointed that their partners, despite or perhaps because of other preoccupations, would not join them in encouraging the developing world to give higher priority to investment in telecommunications. Acting in accordance with their convictions and interests, the Japanese are setting up their own centre for telecommunications development.

It is encouraging that countries of the size and population of China and India are now paying special attention to the telecommunications sector. The same is true of certain states in South-East Asia and the Middle East. But as yet there has been no critical change in attitudes in a majority of developing countries and, sadly, one still hears of major development projects being undertaken without any provision for telecommunications. Though one may bewail this, it must be realised that the intellectual adjustment expected of political leaders striving, in the harshest of conditions, quite literally to ensure the survival of their people is formidable. The authors of 'Investing in Telecommunications', one of whom, Ingidayehu Girmaw, is General Manager of the Ethiopian Telecommunication Authority, suggest a thoroughly practical approach to the problem:

> 'There is a compelling need to develop appropriate strategies for the accelerated growth of telecommunication services in developing countries. In such an endeavour it is essential, however, not to run to the error of comparing the priority of telecommunications with the basic necessities of life such as food, shelter, health or education. Telecommunications should be seen as a tool; they are not an end but a means to an end, and hence should be judged on their catalytic value.'

This is well said. In the end the least developed countries, as well as those with better prospects, must be persuaded not only of the virtues of investment in telecommunications but also of the disadvantages they will suffer – and these will become relatively more serious as time passes – unless they pay more attention to this sector and accord it an adequate share of national resources.

This brings us to the key question: who determines priorities? Ministers of Posts and Telecommunications and managers of operating authorities need no persuasion; there is no point in preaching to these particularly converted. In any case they do not set national priorities. Heads of state or government, finance ministers, planners – it is to these that the message has to be conveyed. The Centre for Telecommunications Development can play a key catalytic role here. The Director and his staff already have ample evidence with which to persuade governments of the importance for their economic development of a high level of investment in telecommunications.

It would be both unwise and unfair to suggest that responsibility for redressing the imbalance in the worldwide distribution of telephones rests solely with governments of developing countries. The Independent Commission addressed several of its more uncomfortable recommendations to governments, international agencies, operators of telecommunications systems, equipment manufacturers and finance houses in the industrialised world. The programme of action advocated by the Commission was predicated on the interest industrialised and developing countries share in the creation of an effective and comprehensive world network. To those in the industrialised world who enjoy the fruits of the micro-electronics revolution, the benefits developing countries stand to gain are clear enough. But the rewards industrialised countries can reap through participating in a joint effort to expand telecommunications in the developing world may not be so obvious, and a sustained exercise in persuasion may well be necessary.

Political instability, debt, sheer poverty, and nationalistic attitudes to foreign enterprise and investment have, in the eyes of many industrialised countries, made the developing world an unattractive market. Generalisations are invariably unjust and misleading, and such a verdict is no exception. Important changes are taking place. Severe economic and political problems have obliged many developing countries to amend their attitudes. Joint ventures and other forms of partnership are increasingly being encouraged. That is not all. As Jean-Loup Dherse, a Vice-President of the World Bank, told a meeting of trade associations in Brussels last year, developing countries are becoming more receptive to the idea of direct foreign investment either in new projects or in the form of transferring government-owned investments to private hands. Other factors are relevant. For one thing, it is a special characteristic of an effective telecom-

Above: *Telecommunications are becoming the world's new trade routes, linking major centres with remote corners of the globe and slowly narrowing the gap between north and south. Photo courtesy of Cable & Wireless.*

munications system which meets demand that it is inherently profitable and that it generates wealth. This should appeal to the entrepreneurial spirit of those in the micro-electronics industry who may be anxious about their ability to survive in the highly competitive and somewhat overcrowded market in the advanced societies. A long cool look may persuade them that the developing world is a fast-growing and potentially the largest market for telecommuniations equipment and expertise.

In commercial terms there could be short-term gains. But what about the longer term? The creation of an effective worldwide network could do more than any other single measure to narrow the gap between north and south. Such a network would make possible instantaneous communication between the great commercial centres such as New York, London or Tokyo and a small provincial town, or even a remote village in Africa, Latin America or China. The world would be on the way to becoming a single market-place – its components interdependent in commerce, manufacture, agriculture, banking, insurance, computer services, and so on. Telecommunications would be the new trade routes. New commercial partnerships would be formed. Demand for new goods would be stimulated. Standards would be set with the world market in view. Design would have to take account of a wide range of usage, aptitude and taste. In due time traditional notions of sovereignty would be eroded; the advantages of interdependence would be more widely accepted; and distinctions between the so-called first, second and third worlds would fade.

For many reasons things will not turn out this way. In practice the world network is likely to develop in an uneven, untidy fashion. This will carry the risk that disparities in rates of growth will increase. While the new industrialising countries, the oil producers of the Gulf and the prospering economies of South and South-East Asia, Central and South America continue their advance – aided by a more effective and comprehensive network – their economic growth will far outstrip that of the least developed, especially in Africa, who will still be struggling to make their existing systems operate at a minimum level of efficiency.

Such an outcome would be no more tolerable than the present state of affairs. To prevent this the essential first step is a decision by governments to give higher priority to improving and expanding telecommunications in the developing world. This message has to be repeated until it is received and understood by all those, in both industrialised and developing countries, who carry responsibility in this field. □

This second edition of *Developing World Communications* is a collaborative project produced by Grosvenor Press International's and the International Institute of Communications (IIC), a policy research institute based in London and concerned with communications world-wide.

The communications environment is still characterised by wide gaps between what is known in one country and what is known in another, between what is available in one and what is available in another, and between the effectiveness of systems and services in different parts of the globe. Equipment that is now commonplace in urban industrial countries is often unavailable in the rural areas of developing ones, or, if it is available, it's too expensive, often because of trade and currency restrictions. It is not uncommon for equipment that is made in the Asia-Pacific region to be exported more easily and more cheaply to the USA and Europe than to some of the developing countries in the same region.

There is also a shortage of information about equipment. Information that can be picked off the floor at trade shows in Berlin and Atlanta, Georgia, may never get distributed in many countries. This imbalance helps no one.

There have been many attempts to bridge these gaps, both between south and north and between south and south. One of the key initiatives was the Maitland Commission set up by the International Telecommunication Union (ITU). Indeed the ITU deserves much of the credit for putting development issues high on the global agenda. It has done so equally at political, manufacturing and financial levels.

The IIC also has a keen interest in telecommunications as a factor in development. It has worked with many international organisations, particularly on the use of satellites for development. With Intelsat it is currently co-ordinating Project Share, involving the use of satellites for health and rural education.

The IIC brings together manufacturers and policymakers, international organisations and private companies. It has members in 80 countries and a commitment to reflect their global concerns in all its activities. With this in mind, the IIC supports the aim of *Developing World Communications* as a means of disseminating expert information on the use of modern communications for development. We hope it contributes to the more equal sharing of such knowledge and ultimately to the more effective use of the most appropriate equipment available.

John Howkins
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GLOBAL TELECOMMUNICATIONS

35

Above: Senegalese and French engineers testing microwave equipment in Northern Senegal: the Centre for Telecommunications Development will strengthen and expand the scope for technical support in developing countries.

THE ITU AND TECHNICAL COOPERATION: NEW MOVES FOR DEVELOPMENT

by Richard Butler

1986 was a significant year for the relationship between developing countries and the International Telecommunication Union (ITU). It saw the establishment of a Centre for Telecommunications Development as part of the ITU, on the recommendation of the report of the Independent Commission for Worldwide Telecommunications Development, 'The Missing Link', presented the year before by its Chairman, Sir Donald Maitland. Complementing the work of the ITU's Technical Cooperation Department, this new Centre is setting out to make the advancement of telecommunications in Third World countries its specific concern. Richard Butler, Secretary-General of the ITU, explains both the background to its conception and its intentions.

***Above:** Administrative conferences organised by the ITU provide an international forum for debate on telegraph, telephone and radio regulations and related issues of worldwide importance.*

THE ITU's basic instrument is the International Telecommunication Convention, Nairobi 1982. This provides the means of responding to international telecommunications development requirements until the next, 11th

Plenipotentiary Conference planned for 1989 in France, and is the outcome of the Nairobi Plenipotentiary Conference.

Before turning to the structure, let us remember that the purpose of the Union, as set out by the plenipotentiaries at Nairobi, is:

☐ to maintain and extend international cooperation between the members of the Union for the improvement and rational use of telecommunications of all kinds, as well as to promote and to offer technical assistance to developing countries in the field of telecommunications;
☐ to promote the development of technical facilities and their most efficient operation with a view to improving the efficiency of telecommunication services, increasing their usefulness and making them, so far as possible, generally available to the public;
☐ to harmonise the actions of nations in the attainment of those ends.

Accordingly, the Union works unremittingly on regulation, coordination, standardisation and planning for international telecommunications. In addition, its General Secretariat assembles international telecommunications data which are published for the benefit of telecommunications engineers and operating authorities. There are lists of radio stations and telegraph offices throughout the world, statistics, maps, charts and tables. The Union also takes part in economic and social development activities, through its Technical Cooperation Department as well as through the newly created Centre for Telecommunications Development, whose functions are described later.

Regulations

International regulations on telecommunications are prepared during conferences convened by the ITU. These include:

☐ World Administrative Conferences which revise the administrative regulations: the telegraph regulations, telephone regulations and radio regulations which govern international use of the three modes of communication;
☐ Regional Administrative Conferences which examine particular telecommunications issues of a regional nature.

Coordination of frequency use

The ITU coordinates and manages the radio frequency spectrum at administrative conferences. These are backed up by residual and continuing actions of the International Frequency Registration Board (IFRB), which consists of five elected officials from the five regions of the world.

The board's main task is to decide whether radio frequencies which countries assign to their radio stations (and which they have notified to the board) are in accordance with the convention and the radio regulations and will not cause harmful interference to other stations. If the board's finding in a particular case is favourable, the frequency is recorded in the master international frequency register kept by the IFRB (with over a million entries) and thus obtains formal international recognition and protection. An average of more than 1,200 frequency assignment notices, covering new assignments or changes to existing assignments, arrive at the IFRB each week.

The IFRB also participates, at the request of governments, in the obligatory intergovernmental coordination of the use of frequencies involving space techniques, prior to their notification for recording in the master register. It is further concerned with the orderly recording of the positions assigned by countries to geostationary satellites with a view to ensuring formal international recognition thereof, together with other permanent organs involved in the technical preparation of radio conferences.

The General Secretariat is directed by the Secretary-General and assisted by the Deputy Secretary-General, both of whom are elected by the Plenipotentiary Conference. The Secretary-General takes all actions required to ensure economic use of the Union's resources and is responsible to the Administrative Council for all the administrative and financial aspects of the Union's activities, including technical cooperation programmes, dissemination of information, secretarial support for conferences and coordination of work with other organisations. The Secretary-General also acts as the legal representative of the Union.

Standardisation and planning

Standardisation is effected by the International Radio Consultative Committee (CCIR) and the International Telegraph and Telephone Consultative Committee (CCITT). These committees are each headed by a director elected by the plenipotentiary conference and draw up a list of technical telecommunication subjects or 'questions', the study of which would lead to improvements in international radio communications or international telegraphy and telephony. These questions are then entrusted to a number of study groups, composed of experts from different countries. The latter draw up recommendations which are submitted to the next plenary assembly. If the assembly adopts the recommendations, they are published. CCIR and CCITT recommendations have an important influence with telecommunications scientists and technicians, operating administrations and companies, equipment manufacturers and designers worldwide.

The Technical Cooperation Department

The signatories of the United Nations Charter in San Francisco in 1945 felt that a durable system of international peace and security could not be achieved unless effective measures were taken to solve the major economic and social problems with which the nations of the world were faced.

The problem of economic development, in particular, has become one of the main concerns of the General Assembly and of the Economic and Social Council (ECOSOC) and has led to the establishment of far-reaching international programmes of technical cooperation in developing countries.

By Resolution 2029 (XX) of 22 November 1965, the General Assembly of the United Nations decided to consolidate the Expanded Programme of Technical Assistance (EPTA) which had started in 1949 and the Special Fund set up in 1950 into a 'United Nations Development Programme (UNDP)' with effect from 1 January 1966.

One of the great virtues of telecommunications is the role it plays in economic and social development. In many countries network capacity is not growing fast enough to meet the requirements of users both inside and outside these countries. In this century of progress, in which economic and social advancement is inconceivable without an adequate telecommunications network, it can be noted that the growth in gross national product follows a curve very similar to that of the increase in the number of telephone stations. In a race against time, more equipment and, above all, more technicians are needed to meet the imperative need for a smoothly-operating worldwide telecommunications network.

Throughout its 122 years of uninterrupted existence, the ITU has served as the medium through which member countries can 'coordinate efforts with a view to harmonising the development of telecommunication facilities . . .' the world over. Its work in the fields of international regulation, planning, coordination and standardisation is the very basis of this constant cooperation.

There is, however, another level of cooperation which is aimed at the improvement of telecommunications equipment and systems in developing countries by means of the dissemination of information and advice, the transfer of know-how, institution building and the enhancement of self-reliance among less advanced administrations. This level of technical cooperation is the role and responsibility of the Technical Cooperation Department (TCD) of the General Secretariat, much of whose work is the execution of telecommunications projects within the framework of the UNDP. However, to an increasing extent, recipient countries and third-party donors are calling upon the services of the Department to execute technical cooperation projects.

Following a decision by the 1959 Plenipotentiary Conference of the Union in Geneva to participate actively in the technical assistance programme of the United Nations, a Technical Cooperation Department was established in 1960 within the General Secretariat of the Union to deal specifically with projects for the advancement of developing countries. When, in 1966, the Expanded Programme for Technical Assistance merged with the Special Fund to form the UNDP, the ITU became the recognised executing agency for UNDP-funded telecommunications projects.

By 1967 the department employed 14 professional and 22 general service staff and administered a programme of just under $5 million.

Now the department's staff amounts to 45 professionals and 50 general service staff distributed among the following divisions:

☐ four regional divisions (covering respectively, Africa, the Americas, Asia and the Pacific and Europe and the Middle East);
☐ an administrative division (which incorporates support services for the recruitment and administration of field experts, for the organisation of fellowships, for the procurement of equipment and for budget control);
☐ a training division;
☐ a group of engineers;
☐ the voluntary programme support unit; and
☐ the telecommunication economics unit.

In the implementation of a decision of the Plenipotentiary Conference (Nairobi 1982), a number of project officers of the regional divisions have been posted into areas of the regions which the department serves. There are now seven Technical Cooperation area representatives in:

Africa:	Dakar, Senegal Harare, Zimbabwe Yaounde, Cameroon
Americas:	Santiago, Chile Tegucigalpa, Honduras
Asia/Pacific:	Colombo, Sri Lanka Jakarta, Indonesia

The department executes, in any given year, between 170 and 200 projects. Over 2,000 man months of expertise, and from 600 to 800 fellowships, are provided to developing countries annually. Equipment to support the projects is purchased, the value normally lying between $4 million and $8 million, and the total annual expenditure on field activities amounts to about $25 million.

The Union's technical cooperation activities fall primarily into three categories. These are:

(i) the promotion of development of regional telecommunications networks through studies and surveys. These are carried out by experts engaged by the Union working in collaboration with member countries, the UN Economic Commission and other regional organisations and funding institutions such as the World Bank or regional development banks;

(ii) the strengthening of national telecommunications technical and administrative services in developing countries, covering practically all branches of telecommunications. As well as providing expertise, this includes fellowships and substantial amounts of equipment;

(iii) the development of human resources. Almost two-thirds of the total field expenditure of the Union's technical cooperation programmes was disbursed for the training of staff to meet the manpower demand in various sectors of telecommunications in developing countries.

Through the assistance of the TCD, modern regional telecommunications networks have been set up, or are in the process of being set up, in Latin America, Asia, Africa (PANAFTEL) and the Mediterranean and Middle East (MEDARABTEL). Numerous national networks have been upgraded and expanded. In the case of PANAFTEL and MEDARABTEL, the two major projects for the development of regional networks, the emphasis has now swung from the initial implementation of the network to operation, maintenance and expansion of the network both in terms of capacity and coverage and in the range of services which it can offer. The introduction of new technologies in these networks is also engaging the attention of the project staff and their counterparts in the countries concerned.

A projected regional African satellite communications system for the development of Africa, known under the acronym of RASCOM, is also progressing to the stage where a full-scale feasibility study will be initiated, in order to define the parameters and characteristics of the system to be installed.

In addition, valuable assistance has been rendered to a number of administrations, especially in Africa, by the drawing up of master plans for the long-term development of their networks. These cover all aspects of telecommunications development, including technical, manpower and training requirements.

Supporting the personnel operating in the field, a group of engineers in the ITU headquarters is responsible for rendering short-term assistance to the member countries requesting it, either by correspondence or by missions to the countries concerned. These engineers provide information to facilitate the planning and development of networks. For this purpose they cover the major technical areas in the field of telecommunications.

The department also comprises a training division whose activities focus on the establishment of international training standards in telecommunications and the international exchange of training materials.

In 1983, a further dimension was given to the Technical Cooperation Department with the creation of a telecommunication economics unit. This was to research the contribution of telecommunications to economic and social development by measuring in quantitative terms the savings and additional benefits which can be attributed to telecommunications and comparing them to the cost of providing these services.

Finally, to respond to the need for increased technical cooperation, a Special Voluntary Programme for Technical Cooperation was established by the Plenipotentiary Conference (Nairobi, 1982) under Resolution No. 19 to supplement existing activities and to provide support to developing countries in the form of expert services, training services, equipment or whatever form required to meet their telecommunications needs more effectively. The programme started its operations in early 1984.

In order to seek wide support for projects implemented under the programme, appeals are made regularly to member countries, their recognised operating agencies or industrial organisations and other entities and organisations to obtain contributions in cash or in kind.

The Centre for Telecommunications Development

The Centre for Telecommunications Development became operational in September 1986.

Background

One of the major topics on the agenda of the Plenipotentiary Conference of the ITU in 1982 was the important part played by telecommunications in the economic and social development of all countries. Concerned by the ever-increasing 'telecommunications gap' between the developing and industrialised world, the plenipotentiaries adopted a number of measures aimed at finding ways and means of improving the situation. Among these was the creation of an Independent Commission for Worldwide Telecommunications Development, whose mandate included the task of recommending a range of methods, including novel ones, for stimulating telecommunications development in developing countries.

Seventeen eminent personalities drawn from the different regions of the world and representing a wide cross-section of interests and experience, served as members of the Independent Commission, which was chaired by Sir Donald Maitland. After deliberating for over a year, the Independent Commission presented its report entitled 'The Missing Link' to the Secretary-General of the ITU in January 1985.

One of the most significant recommendations contained in the Independent Commission's report was the establishment of a Centre for Telecommunications' Development to strengthen and expand the scope of advisory services to developing countries in the field of telecommunications.

In 1985 the ITU Administrative Council established within the framework of the Union, and in Geneva, a Centre for Telecommunications Development on the basis of voluntary funding from governmental and non-governmental sources. In accordance with the recommendation of the Independent Commission, an Advisory Board of 21 members, including its Chairman and Vice-Chairman, provide guidance to the Centre. Board members, drawn from different regions of the world in agreement with the administrations of their respective countries, represent various interests (such as government, telecommunications operators and industry, users). The Secretary-General of the ITU is the ex-officio Senior Vice-Chairman of the Board.

With the subsequent formation of the Advisory Board, the concept of the Centre for Telecommunications Development had become a reality.

Mandate

During its meetings between November 1985 and June 1986, the Advisory Board deliberated on major policy issues regarding the Centre, its scope of activities, fund-raising and staffing. The mandate of the Centre which was adopted can be summarised as follows:

With the aim of strengthening and expanding the scope and the extent of multilateral advisory services and technical support to developing countries, the purposes of the Centre for Telecommunications Development are:

(i) to emphasise and promote the importance of telecommunications infrastructures and services as key factors of socio-economic development, and to promote co-financing and collaboration for telecommunications projects;

(ii) to identify and provide advisory services as well as operational and technical support to developing countries;
   a) in the formulation of their telecommunications policies, objectives and strategies for the evolution of their networks and services;
   b) in the assessment of their needs and in the planning of their telecommunications infrastructure and services;
   c) in the formulation of master plans and of the implementation of programmes including the determination of financing opportunities from commercial sources or under international assistance programmes;
   d) in the implementation of their development plans and in the enhancement of the quality, efficiency and effectiveness of their telecommunications facilities and services.

(iii) to collect information about available resources (in cash and in kind) and to coordinate the mobilisation of such resources for telecommunications development.

The Advisory Board also adopted a statement of policy defining the Centre's scope of action as follows:

☐ to assist nations in identifying sources of financing and support in cash and in kind;
☐ to provide background information to the Technical Cooperation Department (TCD) which deals with such specifics as equipment specifications, computer costs, data and tenders;
☐ to prepare terms of reference for potential consulting services;
☐ not to engage in competitive evaluations of supplier products;
☐ not to duplicate any efforts of the TCD, including involvement in telecommunications operations, but seek to promote the principle of complementarity;
☐ not to afford economic advantage to any company or nation, or constrain the development of worldwide markets;
☐ not to undertake any activity that is not properly funded and budgeted as to time and resources required for completion, unless so authorised by the Board.

A further point stressed in the mandate is the importance of complementarity in the work of the Centre and the TCD, so as to avoid duplication of effort and the ineffective use of the limited resources available.

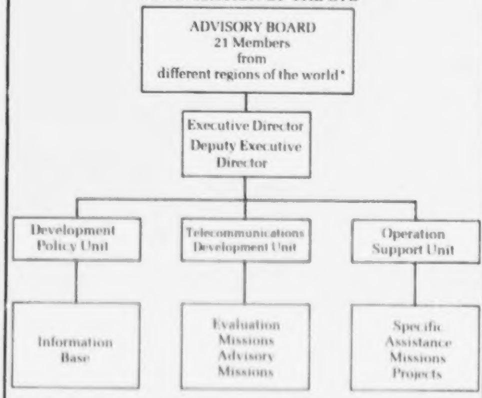
Funding

The Centre, which provides its services to developing countries on a non-profit basis, is financed entirely by voluntary contributions in cash as well as in kind from governmental and non-governmental sources in both developed and developing countries.

Structure and start-up of activities

In June 1986, the Secretary-General approved the recommendation of the Advisory Board for the appointment of the Executive Director and Deputy Director of the Centre. The Directors took up their duties in September 1986.

ORGANISATION OF THE CTD



* 11 members from developing countries
9 members from industrial countries and – ex officio – the Secretary-General of the ITU

The Centre is organised to carry out its activities as a consultative mechanism in matters of telecommunications development as well as in providing field assistance programmes. Three functional units, whose staff was scheduled to enter into service during the first trimester of 1987, will undertake the following tasks:

The Development Policy Unit

The collection, analysis and dissemination of information on telecommunications policies, including the role of telecommunications in economic and social development throughout the world, to assist developing countries in the formulation of the most effective policy for the evolution of their networks.

The Telecommunications Development Unit

By means of multidisciplinary consultancy missions to provide advice to developing countries, on request and at the pre-investment stage, on the creation and operation of an effective telecommunications system.

The Operations Support Unit

The provision of specific assistance including preparation of plans, preparation of specifications for projects, assistance with manpower planning and training, management assistance, assistance in research and development.

During the interim period before the three units become operational, the collation of basic information on the status of telecommunications in developing countries, as well as the needs of these countries, is being undertaken in collaboration with the Technical Cooperation Department. The information base will comprise an inventory of technical cooperation activities already undertaken by the ITU, as well as those needs for technical assistance which are at present identified but for which the necessary funds have not yet been secured. The inventory, which will eventually be incorporated into a computerised data base, will be used as a reference by both the Centre for Telecommunications Development and the Technical Cooperation Department.

Conclusion

In its 122-year history the International Telecommunication Union has evolved as the focal point of world telecommunications. Its contributions to the development of the worldwide network are substantial. As the 21st century approaches, the ITU will be faced with increasingly complex problems relative to the ever-expanding occupancy of the frequency spectrum and the geostationary orbit.

As the ITU has adjusted in the past to the introduction of new technologies – radio transmission, long-distance cables, satellites – so it will also have to adjust to the restructuring of the worldwide telecommunications network that is expected to result from the introduction of the integrated services digital network (ISDN) and from the widespread adoption of fibre-optic transmission.

As the recognised international forum for the regulation and development of the telecommunications, the ITU will be called upon to resolve many different issues. But, as long experience has shown, the conference processes and technical cooperation responsibilities entrusted to the General Secretariat, coupled with the technical capabilities of the International Consultative Committees and the regulatory expertise of the IFRB, provide tried and proven ways of arriving at solutions. □

FINDING NEW FINANCE

by Bjorn Wellenius

The demand for investment in telecommunications in developing countries is obvious. Yet conventional financing is unlikely to grow substantially. Overcoming chronic underinvestment, therefore, depends largely on using scarce resources more efficiently and in mobilising new sources of funds. Bjorn Wellenius, Senior Economist in the Telecommunications Division of the Industry Department of the World Bank, looks at two methods of financing which could provide a richer future.

IN RECENT years, much attention has been given to a malaise that is endemic among developing countries, namely underinvestment in telecommunications. That not enough is invested in telecommunications is evident inter alia from the large number of unmet demands for connections and traffic, the resulting communications bottlenecks observable in many countries, the demonstrated willingness of users to pay far more than official tariffs to retain or gain access to service, the high economic returns on investments undertaken and (with adequate tariffs) the high financial returns including mobilisation of substantial funds for government use in other sectors.

The 1980s have witnessed major efforts to assess the impact of telecommunications in national economic development, to make the case for more telecommunications investment, and to mobilise additional financial resources to this end.

However, a large increase in funds, even if sorely needed from the sector's viewpoint, is unlikely to be generally forthcoming in the foreseeable future from the usual sources. A discussion of telecommunications financing thus leads us to focus on more efficient use of the limited available resources, and on possible changes in sector structure which could attract new sources of funds.

Left: The telecommunications industry now has greater business and political prominence than ever before both in industrialised and developing nations, opening up new possibilities for financing. All photos courtesy of Cable & Wireless.

Sources of financing and related issues

Ten telecommunications sector development programmes recently appraised and partly financed by the World Bank in Africa, Asia and Latin America, provide a useful reference for such a discussion. On average, these programmes each involve investment of about $500 million over a period of about five years. The investments are funded by a mix of

- ☐ internal generation,
- ☐ bilateral aid and commercial credit,
- ☐ multilateral development loans and credits,
- ☐ government loans and budgetary contributions,
- ☐ subscribers, and
- ☐ other sources.

Table 1 shows the share of each of these sources for the 10 programmes.

Table 1:
Sources of financing of 10 recent telecommunications sector programmes supported by the World Bank

	%
Internal generation	45
Bilateral and commercial	23
Multilateral	15
Government	13
Subscribers	3
Other	1
Total	100

Internal generation

By far the largest single source of funds for telecommunications investment among the 10 countries examined is internal generation, i.e. the operating entity's available cash after debt service. All programmes rely heavily on internal funding, which accounts on average for 45 per cent of total financing.

The revenue side of the internal generation of funds is conditioned by tariffs, generally established by government. An essential objective of tariffs is to ensure sufficient revenues for the telecommunications enterprise to meet all costs and generate a reasonable proportion of funds for expansion.

Other important objectives of tariffs are to promote economic efficiency in the use of existing plant and in the allocation of new resources, and to help implement broader country economic and social development objectives (e.g. regional growth, income redistribution). These are generally conflicting objectives, and sorting out a compromise tariff structure and level is a difficult task, complicated further by political pressures and lack of reliable data. Tariff structures often bear little relationship to costs, resulting in economic inefficiency. Likewise, administrative procedures to adjust tariff levels (e.g. in response to inflation) are often cumbersome and slow, adversely affecting the financial results of the operating entities and their capacity to sustain planned growth.

Revenue considerations also highlight customer satisfaction. Quality of service, marketing, development of new services and public relations are all important aspects of running a telecommunications enterprise well, which too frequently receive little or no attention in developing countries. Timely and accurate billing, prompt collection of bills (including from government subscribers) and effective financial controls, are areas where considerable improvement is also often possible.

A prime candidate for cost reduction is the investment programme itself. Average expansion costs in developing countries range from about $1,500 to over $5,000 per telephone line added. This results partly from variations in network size, density and other system parameters. More generally, however, investment cost, as well as operating and maintenance performance, reflect differences among enterprises regarding managerial and technical competence, autonomy to operate as business oriented utilities, procurement and financing practices, and other institutional factors amenable to considerable improvement.

Regarding operation and maintenance, there is generally ample scope for increasing labour productivity. Conventional simple indicators, such as the number of telecommunications staff per 1,000 telephone lines in operation, show huge differences among developing countries from about 10 in some Latin American countries to almost 200 in parts of Asia – which cannot be fully explained by differences in labour costs, mix of services, use of contractors and other factors. Progressive telecommunications administrations set targets to improve labour productivity year by year, which is more important than the absolute level. Maintenance materials and transportation are another major expense where costs can be reigned in.

Bilateral and commercial sources

External financing from foreign commercial banks, suppliers, export credit agencies, bilateral aid agencies and development aid funds as a group constitute the largest source of external financing for telecommunications investment in developing countries. Eight of the 10 recent telecommunications programmes supported by the World Bank resort to these sources, which financed 23 per cent of all funds invested.

Such bilateral and commercial sources can provide financing at a low cost. However, telecommunications operating enterprises with limited international procurement and financing experience, or which prefer commitments to only one or a small number of sources, may find the advantages of such arrangements offset by high prices of goods and services, and by limited (and sometimes outdated) technological choices. Strengthening the enterprises allows them to benefit from more effective competition among both suppliers and sources of financing (including aid).

Multilateral sources

Multilateral development banks, such as the World Bank and African Development Bank, have a small but significant presence in telecommunications financing in developing countries. Among the 10 programmes referred to earlier, multilateral sources provided 15 per cent of all funds (23 per cent if the two largest programmes are excluded). Two of the 10 programmes make use of more than one multilateral source of financing.

The World Bank has altogether made more than 100 loans and credits amounting to about $3 billion to some 40 developing countries to help finance telecommunications investments worth about $12 billion. This makes the World Bank the sector's largest source of multilateral financing. Even so, telecommunications accounts for only 2 to 3 per cent of annual Bank and International Development Association (IDA, a World Bank affiliate) operations. The current trend in Bank lending is to increase the number and size of telecommunications loans and credits, and to mobilise additional funds through cofinancing with other sources. However, this expansion will depend heavily on governments' sectoral priorities for borrowing from the Bank, and on their commitment to sectoral improvements leading to more efficient use of resources.

Government funds

Only three of the 10 programmes need government financing. Government funds are providing only 13 per cent of total funds – 10 per cent in loans and a bare 3 per cent in budgetary contributions. This highlights an important characteristic of telecommunications: properly organised and managed, the sector can develop without recourse to government funds for operation or investment. In fact, telecommunications is often the only public service capable of making a net contribution of funds to government (mainly through corporate and excise taxes, duties, and sometimes subsidies to postal services). This helps overcome one of the most pervasive constraints on development, namely the governments' limited domestic resource mobilisation capability. During their implementation, the 10 World Bank-supported programmes are expected to generate net revenues for government equivalent to 34 per cent of the programme's investments (many times more during the life of the investments).

This net flow of funds to government is over and above meeting all costs of providing telecommunications services, including the repayment of loans and credits. It is also after subsidising services in rural and low-income urban areas, which although economically justified and responsive to broad national development priorities, are often less profitable than average or operate at a loss.

Subscriber financing

Subscribers as a group generally end up paying for all investment – the question is rather who pays, and when. Expansion is traditionally financed mostly by current subscribers (operating surplus), partly paid for later by both current and new subscribers (debt service), and only to a limited extent borne alone by the new subscribers (initial connection charges). Some countries have tilted this balance by making the new subscriber pay up front a large part (or all) of the investment needed to connect them.

Only one of the 10 programmes reviewed had such a scheme, accounting on average for 3 per cent of all funds. The potential for subscriber financing is, however, much greater. For example, Brazil financed 22 per cent of its unprecedentedly rapid telecommunications development in 1974-83 through mandatory purchase of TELEBRAS shares by new subscribers. Japan's post-Second World War telecommunications (and bond market) development was largely based on subscriber purchase of long-term telephone company bonds by new subscribers. Thailand had until recently a two-tier bond system, in which all new subscribers purchased long-term bonds issued by the telephone company; those who bought the larger bonds were given preference for new connections. In Turkey, the PTT offers priority connection (in a few months against an average of about 10 years) to subscribers willing to pay a one-time premium of $600-900. India's 'Own Your Telephone' scheme also gives priority to applicants willing to pay higher connection charges.

The income inequity that can be attributed to subscriber financing can be offset by simultaneously supplying public telephones in low-income areas, or by reserving a part of the new supply at the regular low fee to connect new subscribers by order of application. It may be noted, furthermore, that if financing is a constraint on telecommunications expansion, all potential subscribers, regardless of income, will eventually be connected quicker if some of them pay much more than average up front. As demand is met, of course, the mandatory initial contribution must gradually decrease, and ultimately should not exceed the marginal cost of subscriber connection. So, in effect, subscriber financing offers potential subscribers a choice between price and time – thus it not only serves a financing function, but also an economically efficient allocative function.

Other sources

The main 'other' source in the sample of World Bank supported projects is the United Nations Development Programme (UNDP), accounting on average for less than 1 per cent of funds. This probably underestimates the UNDP's contribution, since it mostly funds preinvestment studies usually done before multilateral agencies initiate preparatory work – which may not be included in programme cost estimates.

Trends in telecommunications financing

Two classes of telecommunications financing for developing countries are receiving increasing attention:

☐ cofinancing between multilateral development banks and various other sources and

☐ financing by private investors.

Cofinancing

For all developing countries as a group, multilateral development banks provide only about 4 per cent of all funds invested in telecommunications. Whereas this figure may increase somewhat, the order of magnitude will not. The main way in which multilateral banks can help mobilise considerably more funds is through cofinancing with other sources, mainly commercial banks, export credit and aid agencies.

'Cofinancing' denotes any one of several mechanisms whereby a financing package for a given investment programme is put together through formal coordination and risk sharing among several sources, drawing on the comparative advantages of each one. The

World Bank, for example, contributes detailed project preparation, appraisal and supervision, in the context of broad macroeconomic and cross-sectoral policy dialogue with government, which commercial banks, export credit and aid agencies are not as well equipped to undertake. Also, the World Bank's leverage with government gives the cofinanciers added assurances of loan repayment.

To the borrower, cofinancing with a multilateral development bank offers several advantages relative to separate arrangements with each source. First, it ensures that all critical parts of the programme are funded in a single package, thereby averting the risk of partial financing delays that could adversely affect the whole programme. Second, properly used, cofinancing can result in low prices and a wide range of technical choices, as well as in low financing costs. Thus, it can combine the benefits of international competitive bidding and tied financing, which are normally hard to obtain together. Third, by reducing risk to commercial lenders, cofinancing typically results in better terms (mainly longer repayment periods) than separate commercial loans. Lastly, cofinancing may in some situations result in increased voluntary commercial lending (i.e. new loans not tied to debt rescheduling) to the country, benefiting telecommunications as well as freeing funds for use in other sectors.

There are three major modalities of World Bank cofinancing: joint financing, parallel financing and B-type loans. All three are relevant to telecommunications, the choice of instrument depending on the particular country's situation and sector needs.

Under **joint financing** the World Bank and each cofinancier disburse (in proportion to their participations) against each eligible expenditure. For example, export credits may cover 85 per cent of each contract and the World Bank can meet the 15 per cent down payments. This ensures 100 per cent financing. However, the World Bank can do this only if its own procurement guidelines are followed, which requires full international competitive bidding and contract award to the lowest evaluated bidder considering price alone – which does not promote competition for financing. This can be overcome by advance negotiations with major supplier countries of the terms of financing (e.g. export credits) that would apply should a bidder of that country win the contract.

The World Bank helps borrowers contact and negotiate with potential cofinanciers on the basis of its knowledge of prevalent financing conditions and practices worldwide. It also helps organise procurement and bid analysis. World Bank joint financing can result in low prices and often very competitive financing. However, with joint financing the borrower risks having to finance most of the contract himself or out of limited available Bank funds, should the lowest bidder be from a country for which good financing is not available, or should agreed terms fail to materialise. Also the Bank's procurement guidelines may be unacceptable to some cofinanciers; this has made joint financing less common in recent years.

In **parallel financing** each source finances different packages of goods and services in accordance with its own rules. The packages are defined in advance of inviting bids, taking into account the likelihood of competitive financing. For example, large contracts for telephone switching and microwave systems often attract a good mix of export and commercial credits, so they can be packaged separately from cables, hardware, poles, towers and measuring instruments, which generally do not. Bids not to be financed by the World Bank can be evaluated for both price and terms. World Bank funds are used for the procurement of goods unlikely to attract good financing. The World Bank helps borrowers organise the procurement process (which can be quite complex), including the definition of packages and bid evaluation criteria and procedures. However, under parallel financing, the World Bank cannot meet the down payments for packages not procured according to its own guidelines. Also, packages offered for other financing normally cannot be picked up by the World Bank if they fail to attract good terms, except under special circumstances.

B-type loans are syndicated loans, generally led by commercial banks. The World Bank can be present in various ways. Through direct participation, the World Bank contributes part of the funds lent (not over 25 per cent, generally 10 per cent or less). A default against the syndicated loan is a default against the World Bank and invokes the guarantee of the borrower's government – hence a small participation by the World Bank ensures its full cooperation in efforts to remedy defaults. Alternatively, the World Bank can guarantee repayment of the loan in the outer years, which allows commercial banks to extend the amortisation periods. Another way is for the World Bank to guarantee refinancing of any outstanding balance at maturity of a loan with constant payments and variable interest rate. B-type operations are fairly recent – the first ever, in 1983, was for telecommunications, and so far, there have been about 20 in all sectors.

Private sector participation

In most developing countries, telecommunications enterprises are in the public sector – parts of government departments, decentralised government agencies or state-owned autonomous enterprises. A government's shortage of funds and borrowing capacity thus tends to constrain telecommunications investments. Is there then, potential for drawing on private sources of funds, domestic or foreign? The answer largely depends on the prospects for substantial change in sector structure.

Some sector analysts predict that the traditional monolithic state-owned monopoly is disappearing as a general model for telecommunications sector organisation, in developing countries as well as in industrialised nations. This results mainly from five factors:

- ☐ growing and increasingly heterogenous demands for telecommunications services especially from large users,
- ☐ the sustained inability of telecommunications enterprises in most developing countries to meet these demands,
- ☐ the availability of technology that allows needs to be met independently from the established telecommunications enterprises, and at lower costs,
- ☐ the emergence of enterprises seeking telecommunications investment opportunities outside their own countries, and
- ☐ the experience of a growing number of industrialised countries (and a few developing countries) in liberalisation and privatisation of telecommunications.

The pace of sector structure change will vary among countries, of course, but all developing countries are likely to be affected.

In this scenario, developing countries which choose to take advantage of the changing trends may find new opportunities for mobilising resources for telecommunications development.

Subscriber financing has considerable potential whenever there are large unmet demands; for example, in urban areas of most developing countries now and for a long time to come. New services (e.g. data transmission and cellular radio) can be opened up to competitive provision by entrepreneurs capable of obtaining the necessary capital from private sources (domestic or foreign). Also, the restructuring of existing telecommunications enterprises under private corporate law can provide a framework to attract new equity or debt financing from private investors and the public at large, and to sell state-owned stock if so desired. Given a favourable economic climate, foreign investors may also be interested in joint ventures, management contracts and other forms of participation in which they would bring along external private financing which otherwise could not be tapped.

Besides its financing implications, greater participation of the private sector can reduce pressure on the existing public sector telecommunications enterprises, allowing them to concentrate efforts on the still huge task of developing countrywide infrastructures to provide basic services. Added potential benefits are increased autonomy from rules designed for government administration rather than productive enterprises, possible mobilisation of additional managerial and technical talents and increased business orientation of management.

Major adjustments in sector policy and sector structure and regulation are needed for this to take place in an orderly manner.

Conclusion

Telecommunications has been a technologically dynamic sector for years but until recently it has been generally obscure and uninteresting as a business. This is no longer the case. The sector is undergoing major structural changes and has acquired tremendous business and political prominence. This is not limited to industrialised countries, although events there do provide powerful publicity and generate new pressures on (and opportunities for) users, enterprises and governments in developing countries.

In this rapidly changing world environment, overcoming chronic telecommunications underinvestment in developing countries encompasses much more than merely trying to secure a larger share of limited resources. Using existing resources more efficiently, although not a new idea at all, gains pre-eminence. And managers and policy makers can let their minds move away from entrenched sector concepts to explore new possibilities with imagination and courage.

In this process, major international agencies have a growing role to play, helping to identify and assess a broader range of strategic options for developing countries as well as for potential partners in the industrialised world. ☐

Left: The African Development Bank is actively participating in a feasibility study on the African Regional Satellite Telecommunications System (RASCOM), in the belief that a cost-effective satellite communications network is a vital part of communications development in the continent. Photo courtesy of Seditas.

POOLING FUNDS

by Kouassi Apetey, African Development Bank

Telephone availability rates in Africa are among the lowest in the world. The continent's telecommunications infrastructure has to be improved radically if African nations are going to benefit from the opportunities offered by effective international contacts. But severe financial problems stand in the way of modernising and expanding networks. Kouassi Apetey, Deputy Director of the Department of Infrastructure and Industry at the African Development Bank, stresses the importance of cooperation and coordination in making sure that all available resources are used to the best advantage.

UNTIL fairly recently, developing countries considered telecommunications a luxury item to be provided only after investments had been made in other areas such as water supply, highway building and agriculture. Fortunately, as a result of measures taken in a number of places in order to create an awareness of the importance of telecommunications, and also as a result of the very significant impact of properly installed and managed telecommunications networks in certain countries, this trend has now been reversed. Now telecommunications are accepted as an essential element in the development process, complementing other infrastructures, and enabling increased productivity and effectiveness in agriculture, industry, trade and social services. Telecommunications also improve the quality of life by introducing into homes, no matter how remote, television pictures and radio broadcasting, all of which clearly bolster social structures, enrich national cultures and decrease migration towards urban areas in developing countries. In those countries, communications techniques have become a very significant catalyst and investments in this area have had a very noticeable impact on economic growth and development.

In industrialised countries, the use of telecommunications services has become widespread and has diversified at incredible speed, embodying one of the most dynamic and state of the art sectors in industry. At present, manufacturers of telecommunications equipment have an annual turnover estimated at over $100 billion. In 1983 over 600 million telephones were installed throughout the world. Of these, over 80 per cent were installed in industrialised countries. This concentration is even more remarkable considering the density of telephony traffic: over 90 per cent of calls were initiated in these countries.

World economics, and especially world trade, certainly benefit from transmission speed. Decision-making processes are based on an almost instantaneous flow of information, which ensures their effectiveness; the multiplicity of easily accessible information sources improves judgement and increases competitiveness, to the advantage of both buyers and sellers.

Telecommunications in Africa

Of all continents, Africa is the most underequipped with respect to telecommunications. This is a clear reflection of the general status of the African economy in this area, and illustrates the well-known relationship between gross domestic product and the size of investments in telecommunications equipment in any given country. Indeed, the economic situation of the African continent is known to have deteriorated markedly in these past years: as the balance of payments has continued to worsen and the rate of population growth has continued to overrun increases in the gross domestic product, per capita income has dropped by at least 12 per cent in 1985 compared with 1980. Drought has ruined the agricultural economy in many countries and export revenues have fallen drastically as a result of very unfavourable terms of trade.

As a logical consequence, Africa's external debt at the end of 1985 amounted to approximately $162 billion while debt repayment amounted to $19.5 billion, that is, 22.3 per cent of export revenues. The well-known weakness of domestic savings and the stagnation of external financial resources have led African governments to adopt programmes for reducing public investment, and have forced difficult choices between priorities. The latter has sometimes caused the neglect of key sectors such as telecommunications, which is an important conduit for the growth of economic activity – especially in agriculture, a first priority for all planners and decision-makers in Africa. It is hardly necessary to reiterate that, in many cases, networks are embryonic, and that their development stumbles against innumerable difficulties, not the least of which are of a financial, managerial, technical and technological nature.

While sometimes there are quite remarkable differences between countries, it can safely be said that, in general, these meagre networks barely cover half the national territory and are made up of terrestrial links whose expansion and maintenance have to overcome problems of inaccessibility, lack of spare parts and the premature obsolescence of analogue equipment. The existence of vast rural areas, devoid of telecommunications to a very considerable extent, is also characteristic of African countries.

Telephony penetration, for example, is still very limited in comparison with the rest of the world. Though holding 10 per cent of the world's population Africa, excluding South Africa, only has some 4 per cent of the 600 million telephones in the world. Telephone density, on average, is less than 0.7 of a line per 100 inhabitants compared with 2.8 in Asia, 5.2 in Latin America and over 60 in Europe and North America.

African governments, aware of this situation and, above all, of the increasingly important role of telecommunications in development, have since the 1960s taken a certain number of decisions which should favour the development of communications infrastructures in the continent. Of particular importance is the establishment of the Pan African Telecommunications Network, whose implementation is now proceeding more or less successfully, depending on the regions.

The United Nations Programme of the Decade for Transportation and Communications in Africa (1978-1988) set as one of its objectives a penetration level of one telephone per 100 inhabitants between now and 1988, i.e. African countries should increase their present rate of infrastructural growth by approximately 50 per cent in order to attain this objective by 1988. This is obviously impossible, since the current rate of growth barely exceeds 8 per cent.

Within the programme approved for the second stage (1984-1988) of this Decade, the Economic Commission for Africa identified 216 projects with an overall cost of some $2.7 billion.

Needs are not solely limited to equipment which must be imported, however. They also include the cost of project studies, construction of buildings, training of staff and maintenance of existing equipment.

If one sets as an objective a telephone density of at least one per 100 inhabitants within the next 10 years and takes account of an approximate 3 per cent population growth in Africa, it will be necessary to increase the approximately three million existing lines by four million lines, which means a rate of growth of some 8.8 per cent and investments of between $8 billion and $20 billion, depending on whether a low assumption of $2,000 or a high assumption of $5,000 per installed trunk line is used, based on the experience of several African countries. Such capital requirements do not even take into account the problems of industrialisation or of technological research, which are nonetheless an essential adjunct for harmonious growth in terms of African reality.

Sources of financing

For their telecommunications investments, operating entities, be they government administrations or private companies, have to date been able to call upon various sources of financing such as:

☐ self-financing
☐ bilateral governmental aid
☐ suppliers' credit
☐ commercial banks
☐ private financial companies
☐ multinational financial institutions.

It is easy to see that African countries will have some difficulty in getting the $8 billion or $20 billion which will be needed during this 10-year period in order to finance the cost of the necessary work and the importation of equipment, when one appreciates that they have to face problems such as:

☐ a shortage of foreign currency
☐ a dubious credit rating
☐ the comparative neglect of remote areas
☐ the shortage of qualified staff
☐ a need to promote industry and technological research centres.

Accordingly, it is desirable to create conditions conducive to improving the cash flow of operating entities and to seek sources of financing offering soft terms in order to alleviate debt servicing costs.

Since these investments must be integrated in the overall development strategy of each country or group of countries, it is incumbent upon them to turn to these different sources within the framework of their respective national or multinational development plans.

What is the role of these various sources of financing?

☐ Suppliers' credits and funds from commercial banks and private finance companies are comparatively easy to turn to, but they have certain disadvantages: they are tied to specific types of equipment, are offered at very high rates of interest and capital repayment periods are very short.

☐ Bilateral governmental aid, be it in the form of grants or loans, generally comes from industrialised countries and is frequently a reflection of political affinity. Beneficiary countries have no choice regarding the equipment tied to such loans, which sometimes means that prototype equipment is included in a network and this entails additional financial burdens and technical complications for the operating administration. The above-mentioned financial sources, be they suppliers' credits, commercial banks or bilateral aid, are hardly ever concerned with the technical and financial viability of projects and far less with the management capacity of the recipient telecommunications entity.

☐ Multilateral financial institutions, having as their main objective the socio-economic development of the countries with which they are involved, are concerned with promoting the project sector as a whole and with the organisational and managerial capability of the executing agency. That is why, when financing these projects, multilateral institutions are not only concerned with the purchase and installation of equipment, but also with the evaluation of implementing agencies and even with the financial and economic situation of the country as a whole.

During the last few years, Africa has turned to all of these sources of financing in order to promote the development of its telecommunications infrastructure. Banks have responded either individually or through cofinancing. The latter, which fortunately is becoming more widespread, involves both commercial and multilateral development banks, and should be welcomed as a felicitous initiative which can assist African countries in meeting the very considerable level of financial support required by national or multinational projects.

Contribution of the African Development Bank

Under its charter, the Bank has two types of resources. The first, called ordinary resources, includes paid-up share capital, funds obtained through loans, funds received as repayment of loans granted and revenues produced by loan operations. The second is the setting up or management of special funds in order to serve its objectives – a provision made under Article 8 of the Agreement which established the African Development Bank.

In compliance with these provisions, the African Development Fund (ADF) was created in 1972 and the Nigeria Trust Fund (NTF) in 1976. These two funds are the source of concessional loans, whereas the ordinary resources of the Bank are used for a variety of loans under standard terms and conditions. In order to finance pre-investment studies, and detailed technical and design studies, the Bank has established a Technical Assistance Account within the framework of the African Development Fund. These are all the resources of the African Development Bank Group.

From the time it was established until 31 December 1985, the Bank, which participates directly in the implementation of the Pan African Telecommunications Network (PANAFTEL), has financed 27 telecommuniations projects within 21 African countries for an overall figure of 251.02 million units of account, equivalent to an equal amount in US dollars. Bearing in mind the generally high profitability of telecommunications projects, loans are normally granted using the Bank's ordinary funds, except in rare cases which take account of some countries' peculiarly difficult situation. Participation of the African Development Bank in telecommunications represents 7 per cent of the cumulative commitment of the Bank's ordinary resources, which amounted to 3.383 million units of account by the end of 1985, and approximately 4 per cent of the total cumulative commitments of the Group.

Finally, among the Bank's activities in telecommunications in Africa, it should be noted that it is actively participating in an important feasibility study on the African Regional Satellite Telecommunication System (RASCOM). The Bank is a member of the inter-institutional coordinating committee (CCII), entrusted with this study by the Conference of African Ministers of Transportation, Communications and Planning. In view of the importance of the project and its strategic nature for the future of communications in Africa, the Bank Group is preparing to participate in financing the study, which will assist in setting the bases for a decision on the part of African governments concerning the choice of the system and organisational structure to be implemented insofar as management and financing are concerned.

Such a project is definitely within the scope of the Bank, given that one of its main concerns is to assist in creating all necessary conditions for a better integration of African economies. In the Bank's view, one of these conditions is a satellite telecommunications network.

Future prospects

Within the strategy adopted for the economic recovery of African countries and for the renewed growth of the gross domestic product, and within the context of the preparatory work for the fourth capital replenishment presently being discussed, the Bank's departments have estimated that its loan operations could total some $8 billion in the course of the five-year period from 1987 to 1991. Assuming that the share earmarked for telecommunications remains unchanged, some $560 million would be invested in this sector and the figure could be even larger if countries so request.

Learning from experience acquired in the implementation of PANAFTEL and from the general situation of domestic and international telecommunications networks in Africa, the Bank has decided on various courses of action with a view to achieving growth and service quality objectives which are essential for the efficiency of the African telecommunications networks.

a) Studies: In order to have sound feasibility studies, the African Development Bank proposes to call upon bilateral assistance funds and the technical assistance fund of the African Development Fund specifically for telecommunications projects in rural areas. The Bank will also undertake to collaborate more closely with regional and international financial institutions in order to make better use of their own studies with a view to increasing cofinancing possibilities.

b) Range of activities: Investments earmarked for the execution of projects should cover a wide range of activities:

    ☐ large domestic networks
    ☐ inter-country links
    ☐ rural telecommunications
    ☐ multinational research centres
    ☐ industry in the field of telecommunications.

c) It is regrettable to observe that the poor operation of African networks, where telephone availability rates are among the lowest in the world, is frequently due to a lack of spare parts and of qualified staff. Accordingly, it would be useless to invest all available funds in the installation of new equipment, if at the same time no action is taken regarding the old networks. It is of the greatest importance that, in subsequent investments in telecommunications, the providers of funds attribute, just as the Bank plans to do, particular importance to the following aspects:

    ☐ projects for repairing existing installations
    ☐ projects for improving the financial management of operating entities.

Clearly the development of telecommunications in developing countries requires a considerable level of resources which cannot be provided exclusively by any single source. It is thus absolutely essential to endeavour to mobilise funds from all sources, be they private, bilateral or multilateral. The problem is still one of coordinating resources and formulating criteria for supporting telecommunications projects.

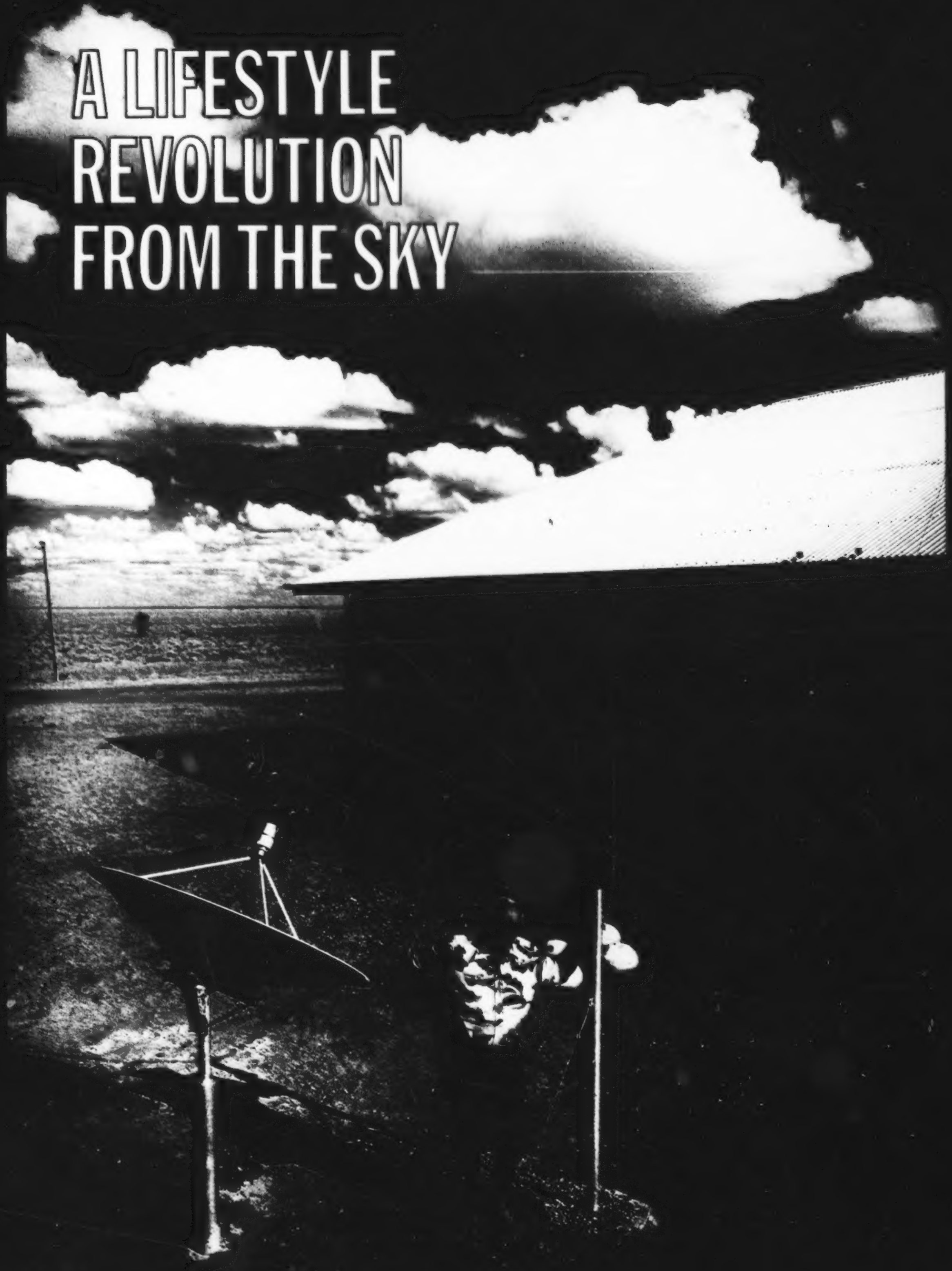
We believe it is absolutely essential that such criteria reflect a certain number of rules shared by all. Specifically,

☐ that the implementation of a medium and long term development programme responds, inasmuch as possible, to the commonality of interests of several countries in a region or sub-region;

☐ that assurances be given as to sound technical, administrative and financial management by the agency receiving the loan. The financing sources should coordinate their actions along these lines and find formulae for joint participation such as cofinancing.

On the basis of past experience increased attention should be given to improved maintenance, to staff training, and to the problems of industrialisation and technology transfer. An exhaustive dialogue should therefore be undertaken with borrowing countries in order to list all the objectives which could contribute to a marked improvement of the networks.

This is the text of a paper presented at Telecommunications for Development: An International Forum, held in New York in October 1986, whose sponsors included Intelsat, New York University, the Economic Development Foundation and the Intergovernmental Bureau for Informatics. ☐



A LIFESTYLE REVOLUTION FROM THE SKY

by Charles Halton

Until very recently, lack of communication with the outside world has been a fact of life for people living in isolated areas. All this is changing, however, with the advent of satellite communications, bringing the possibility of reliable broadcasting and telecommunications services and all the benefits they can provide. Charles Halton of the Department of Communications in Canberra, Australia, describes how the arrival of Aussat is transforming communications networks in the Australian outback.

CONVENTIONAL technology has, until recently, been unable to extend dependable national communications services to remote or dispersed populations in many countries. For isolated people in remote Australia, satellite communications offer the only practicable method of obtaining adequate services within a reasonable time frame. For this reason, the Australian government decided to proceed with planning for a national satellite system.

On 27 August 1985, the first Aussat satellite was successfully launched by NASA's space shuttle, followed by the second on 27 November 1985. These were placed in geostationary orbit some 36,000 km above the equator at 160° E and 156° E. The third satellite of the first generation system was due to be launched in 1987 by the European Ariane launch vehicle.

There are two national beams and four individual regional beams from each satellite. Each of the four regional beams are designed to concentrate the satellite signals in footprints covering about one-quarter of the area of Australia. (see Figure 1). This helps to minimise the cost and size of receive-only dishes used on the ground, and dishes of 1.5m diameter are suitable for reception of satellite broadcast services in most places.

The Aussat satellites, like most of their generation, have their biggest impact in terms of broadcasting – in particular television broadcasting. The most important innovation is the new medium power form of direct broadcasting service. Through direct broadcast satellite technology, up to 350,000 people with degraded or no television or radio services now have the opportunity to receive these directly via satellite.

Figure 2 (left):- Television can be received via receive-only dishes in remote locations from the Homestead and Community Broadcasting Satellite Service (HACBSS).

The Homestead and Community Broadcasting Satellite Service (HACBSS) commenced the transmission of Australian Broadcasting Corporation (ABC) television and radio programmes on 26 January 1986. The four-zone nationwide service allows for time zone differences and for state-based ABC programmes to be fed from the appropriate capital city. HACBSS provides for individual reception of

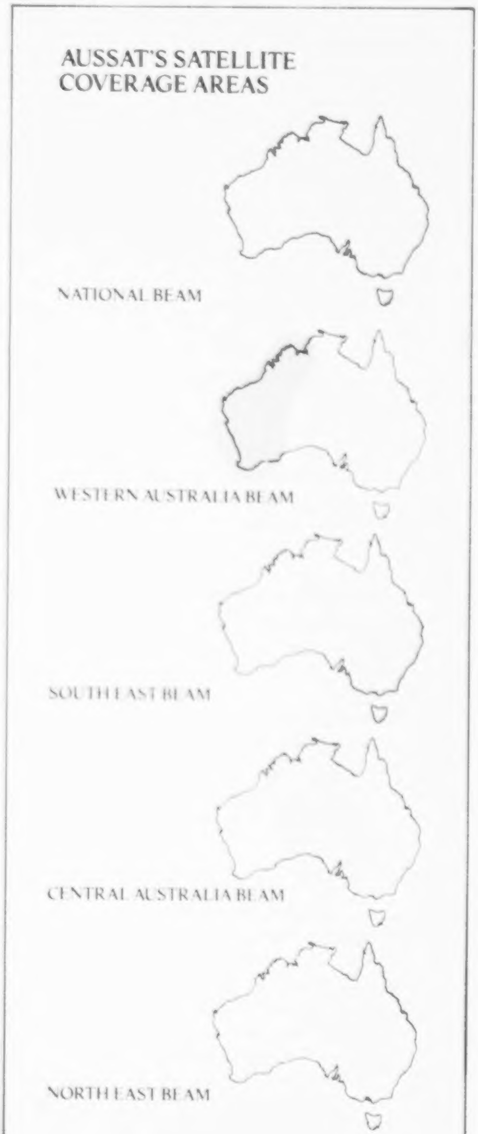


Figure 1: – Aussat's satellite coverage areas.

programmes at isolated locations (see Figure 2). Alternatively, some small communities have opted for a shared reception and redistribution system (see Figure 3).

In addition to HACBSS, one Remote Commercial Television Service (RCTS) is to be provided in each of the four separate regions. Licensees have already been selected through public inquiries conducted by the Australian Broadcasting Tribunal and the service in the western zone, the Golden West Network (GWN), commenced operations in November 1986. GWN plans to use the RCTS signal to disseminate entertainment and information directly to outback homesteads and communities. The service is the first of its type in the world, covering all Western Australia – an area one-third the size of the United States. By November 1986 it was serving about 600 individual receiving stations and 11 community reception/rebroadcast sites.

The services covering the remaining three zones were expected to begin this year. Of particular interest is Imparja Television, the licensee chosen for the Central zone, which is sponsored by the Central Australian Aboriginal Media Association (CAAMA). The proposed service would include programmes tailored to the needs of Aboriginals, as well as other programmes for the residents of remote central Australia. Imparja has suggested that communities within the zone would have the opportunity to insert their own local programmes at rebroadcast sites.

Figure 3 (above):- Small communities often set up a shared reception service in a local centre.

The RCTS is expected to have a distinctive non-urban character, and will be receivable on the same small earth stations as used for ABC HACBSS programmes. Licensees are keen to maximise their investment in satellite capacity and earth station hardware by carrying a range of ancillary communications services as well as the remote television service. GWN, for example, has identified uses for excess satellite capacity covering government, business and community applications. Licensees have also agreed to consider carrying remote commercial and public (community funded and initiated) radio services.

Aussat also provides a cost-effective and flexible method of distributing and relaying television and radio programmes. The ABC relays programmes between studios, distributes programmes to regional transmitters and distributes Radio Australia shortwave broadcast programmes from studio to transmitter. The national multicultural broadcaster, the Special Broadcasting Service, is using the satellite to distribute its programmes to most capital cities.

Commercial television networks also relay programme material between their major studios and to regional stations for rebroadcast (Satellite Programme Services).

The Macquarie Radio Network has established a national satellite-based commercial radio news gathering and distribution system covering 22 stations. In the past, remote and country radio stations have had difficulty in obtaining anything but local news. The satellite now provides them with the same news and information as is available to the metropolitan stations. At locations where terrestrial lines have not been available, Aussat provides a welcome solution leading to an improved service to radio audiences.

Those receiving the satellite broadcasts during the first year of operation (at several thousand individual locations) have remarked favourably on the high-quality television pictures and the near compact disc quality of the radio services. This is in stark contrast to the noisy, fading, shortwave AM radio broadcasts that for outback residents have, until now, been the only source of news, entertainment, information and education. The system's quality is attributed to the use of a new generation of television signal processing, namely B–MAC (for B–Format Multiplexed Analogue Components). Australia is the first nation to use the advanced technology B-MAC system but similar systems have now been adopted elsewhere. (The Australian Broadcasting Corporation explains its decision to use the new system on page 406.)

The governments of states with sparsely populated areas – Western Australia, Queensland and the Northern Territory in particular – are working on proposals for integrated satellite networks to deliver a range of services. The most advanced is the communications network operated by the Queensland govern-

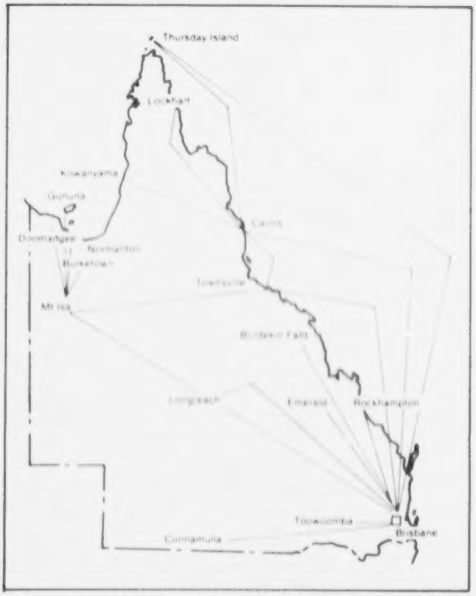


Figure 4 (above):- The Q-NET communications network, operated by the Queensland Government and its agencies, which serves everything from hospital administration to water resource monitoring.

ment and several of its agencies – Q–NET. This is used for telemedicine, orthodontics, hospital adminstration, technical and further education including university administration as well as police communications, railway signalling and water resource monitoring (see Figure 4).

A helicopter-transportable earth station is being tested for use by emergency services in areas devastated by cyclones, floods and other natural disasters. This could provide rapid restoration of important communications links via satellite when terrestrial facilities have been blown or washed away.

Some state governments are also looking at the potential for one-way distribution of educational material – especially video and computer software – and teleconferencing applications, possibly in conjunction with the RCTS licensees.

In distance education, Australia was a pioneer in the use of two-way high frequency radio for the School of the Air (SOTA) which has been operating for nearly 50 years. This is a relatively low cost 'push-to-talk' service, sharing the Royal Flying Doctor Service (RFDS) HF transmitter network in some places. However, its usefulness is limited by the vagaries of HF transmission.

Under a jointly sponsored research project, Aussat provided individual two-way earth stations to the Queensland School of the Air for trials being carried out over the Q–NET system throughout the 1986 school year. These involved eight students' earth stations capable of supporting two-way voice, data and television reception, personal computers for each participant, and two high-performance minor earth stations at Mount Isa and Brisbane (see Figures 5 and 6).

The satellite system provides greatly enhanced reliability and flexibility, immediate teacher/student feedback, and effective group interaction augmented by live video and audio coverage of the teacher. Implementation of services to all outback areas is still some way off, however, because of the costs and the need for further development.

In large areas of outback Australia, the only means of communication is via shared HF radio. This means lack of privacy, long delays when calls are arranged, and poor quality. With the advent of Aussat, however, Telecom Australia, the national domestic telecommunications carrier, now has the means to introduce a range of services to these areas for commercial and business use. (For a detailed description of how Telecom Australia plans to extend its network using both terrestrial and satellite services, see page 214.)

The Department of Aviation has established a satellite-based network for air traffic control and flight service centres, giving improved communications with aircraft. It is expected to result in a rationalisation and reduction in total expenditure on these services, as well as enhancing air safety, operational reliability and flexibility. The 202-station network provides, for the first time, national coverage for aircraft communication and navigation. All flights above 6,000 metres in and around Australia are controlled via satellite in conjunction with existing VHF links. Air route structures and ground resources, particularly in the more remote regions of the country, can now be optimised without compromising safety or reliability.

AAP Reuters Communications has installed a satellite-based telecommunications network connecting more than 50 locations nationwide, and has projected a network connecting more than 1,000 sites across Australia within five years. This will provide the national distribution of news agency information plus specialised financial and other corporate information services.

The availability of Aussat has acted as a catalyst for entrepreneurs to develop new services. As an example, specialised video and audio entertainment and information services are being introduced via dedicated private

Figures 5 and 6 (above and below): - Two-way earth stations being used by a teacher and student of the Queensland School of the Air in a demonstration of distance education.

satellite networks to selected locations such as hotels, motels, registered clubs and sporting and other associations. Ad hoc networks are being configured for special events such as national teleconferencing of annual general meetings and product launches.

In addition, emergency services can now use satellite-based networks in the knowledge that their communications system will thus be unaffected by natural disasters which could damage or destroy a ground-based system.

Demand is emerging for the establishment of additional specialised satellite networks which make use of the latest VSAT (very small aperture terminal) technology, and which could have useful application in remote areas. Organisations with widely dispersed operational locations such as financial institutions, government agencies, mineral exploration companies, construction companies and transport companies, are interested in the establishment of private, small-capacity voice and data networks.

It is thus not surprising that, in its second year, with more than 80 per cent of the Aussat satellite system capacity committed, some people are already describing it as 'a lifestyle revolution from the sky'. The satellites have upgraded communications generally and stimulated the establishment of new services between, and within, remote and urban areas. They have also led to the introduction of new technological, commercial and industrial opportunities.

But much more has yet to be done to ensure that the Aussat communications satellite system is used more effectively by end users in the Australian bush. Lifestyles are bound to change with the coming of satellite services. The challenge for communications planners, carriers and recipients of services is to work together to maximise the benefits of this technology and so enhance life in the Australian outback. □

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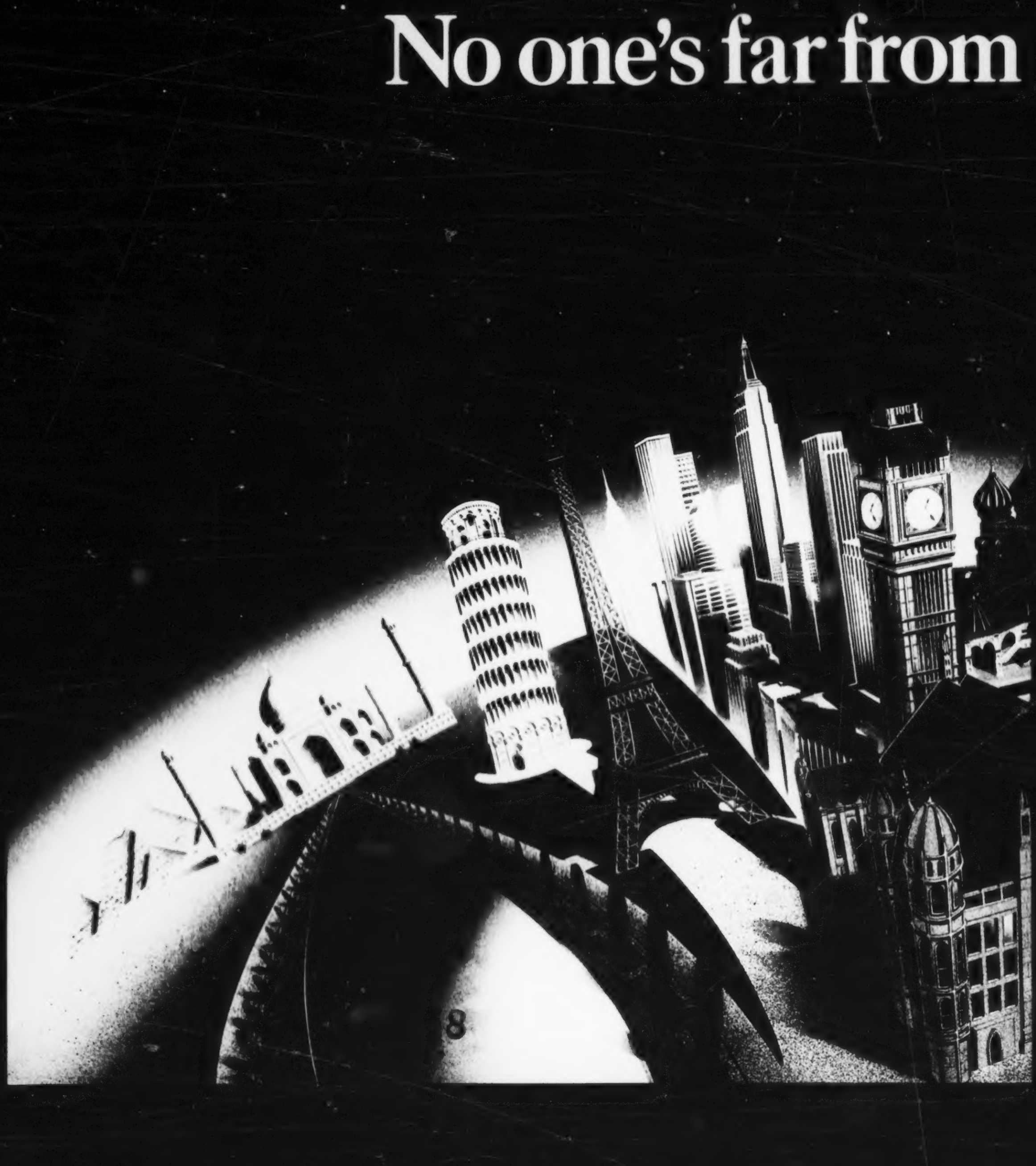
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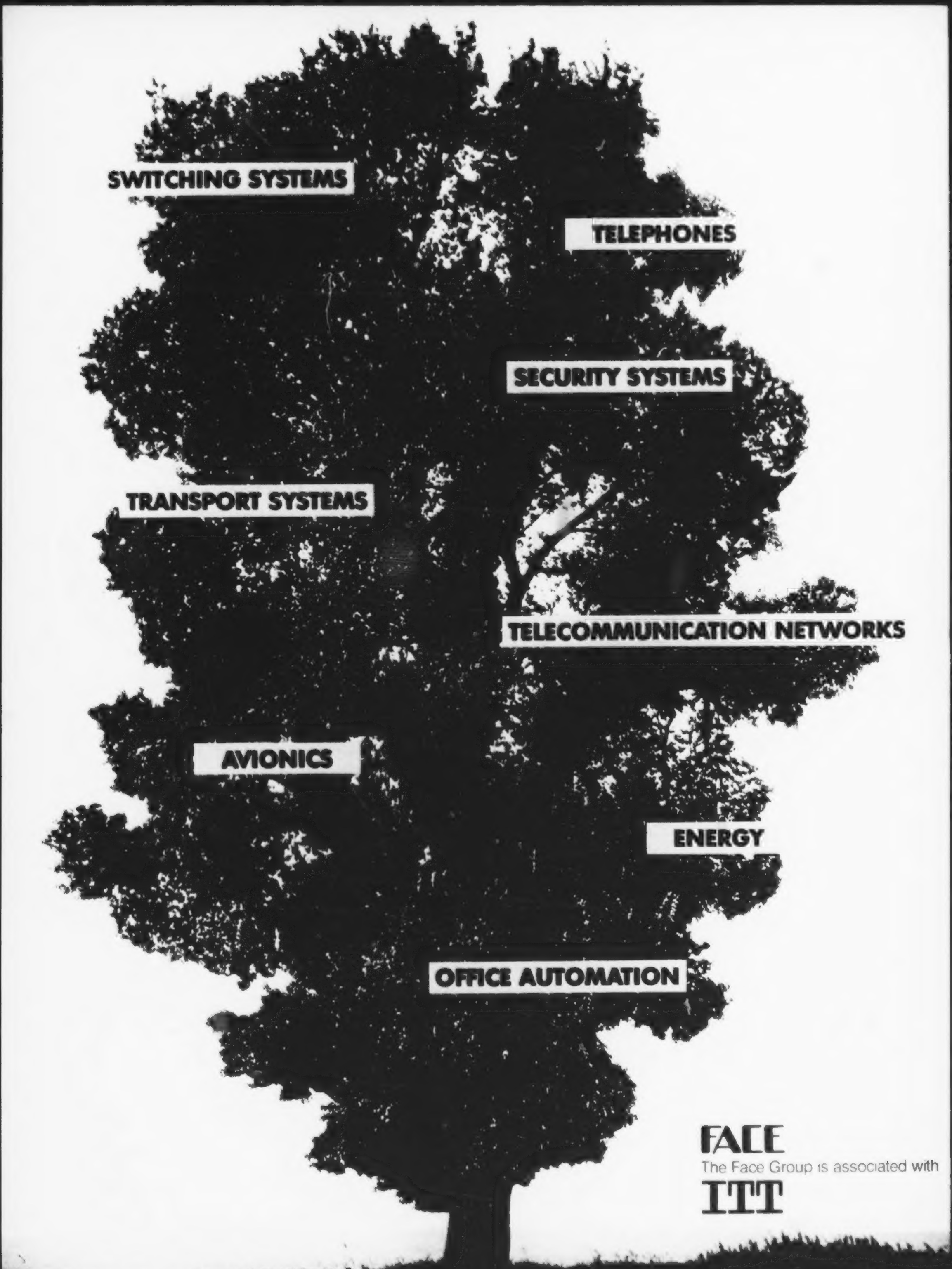
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FACE Group

a commitment to the future of telecommunications

FACE Group is the Italian subsidiary of Alcatel N.V. - the largest European and the second worldwide telecommunications company- and one of the leading manufacturers and vendors of telecom and Business Systems products in Italy, with total sales exceeding 770 bilion lira (600 milion US $), and over 10,000 employees. With origins at the end of the 19th century, FACE has been since the '20s associated with the companies of the ITT Group, up to the birth of Alcatel N.V. in January 1987.

Thanks to this deep international involvement, FACE has been able to develop and join some of the most advanced projects in the industry during these last decades. Examples are the contribution to the birth of new generations of public (e.g. System 12) and private switching systems, new developments in optical fibres transmission, air navigation aids, voice treatment, up to the state of the art in automatic speech recognition.

R&D and manufacturing capability

Today FACE Group is 100% devoted to the information and electronic industry, with the core of this activity in telecommunications and other related businesses, spanning from installation to railway - and road - trafic control to document handling for the banking industry and the post office.

The Group operates through 19 manufacturing units, that are widely spread all over Italy, and with 4 R&D laboratories, which employ 800 scientists and technicians. These are engaged in the most advanced electronics and telecom research, ranging from joint international projects - thus optimizing the global capabilities of the international group to which FACE belongs - to local projects, like the customization of the national requirements for the emerging ISDN standards.

Part of the ISDN advanced projects is for example the development of a new fully digital telephone set, which will provide a high-level user interface approach.

Telecommunications

FACE is among the major manufacturers and vendors in the Italian public communications. Its Public Switch - the System 12 - has been jointly developed by FACE and its sister companies in Europe, and besides being one of the three digital switches adopted in Italy, it actively feeds sales to international customers.

FACE's System 12 has already provided a substantial contribution to the modernization of the Italian telephone network, with about one fifth of the digital lines installed during the last three years, with around 150 switches shipped to SIP, the Italian public telephone company, and with traffic capabilities between few hundreds to well over 10 thousand lines-equivalent. The System 12 family is manufactured in the Battipaglia plant, in Southern Italy, at a rate of one switch per week.

In the end-user marketplace, FACE is a leading supplier of phone sets and of automatic answering equipment. FACE is engaged both in domestic and international markets not only with sales but also with technology arrangements. An agreement in this area has been underwritten with the Indian phone company for the sale of telephone sets and, subsequently, for the support of local production. The group has also developed and manufactures the 5100 BCS a key-system or full PABX (depending on configuration) for small to medium-size customers, up to 24 external lines.

A meaningful part of the group's activity is in the information systems market, from IBM compatibile, syncronous and asyncronous terminals, to control units, printer terminals, local area networks. FACE is also a supplier of a wide array of office products, which include one of the broadest spectrum of personal and supermicro computers, together with a family of impact and laser printer.

In other sectors, FACE Group is a leading supplier in the communications and power networks, and SIETTE, one of its leading operating units, has been named "leading house" in the networks installation market for the entire Alcatel N.V. group. The Group also provides equipment and control technologies in the transport industry: its advanced electronic capability is the key for new generations of control systems for railways and undergrounds networks. In the area of banking and post-office automation FACE provides products like documents selectors, which have also been adopted by financial institutions worldwide.

FACE is associated with Alcatel N.V.

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A WORLD OF EXPERIENCE LORAL TERRACOM AND MICROWAVE RADIO COMMUNICATIONS

THIS article is not a story of space technology and how it enabled man to walk on the moon. Rather it is a story of the technology that allowed mankind to witness this historic event; microwave communications. In particular, it is the story of quiet advances in technology and their implementation at Loral TerraCom, a manufacturer of microwave transmission and digital multiplex equipment.

Loral TerraCom is the leading supplier of portable microwave radio systems to military forces and telephone administrations worldwide. In 1971, TerraCom was formed in response to the communications industry demand for a versatile, high quality and cost-effective microwave radio system for emergency restoration of communications and for the provision of temporary communication link services. The response of TerraCom to those requirements was the TCM-600 microwave radio system, which continues to set new versatile microwave communications systems standards.

In 1974, TerraCom was acquired by Loral Corporation, which not only broadened Loral's base of communications expertise, but increased the depth of the technical and financial resources of TerraCom. In 1983, TerraCom's designation within the Loral group became what it is today, Loral TerraCom.

Located in Southern California, in the heart of San Diego's dynamic high-techology electronics industrial base, Loral TerraCom is a technology-oriented company in an industry where new product development is essential to continued growth. The latest computer-controlled systems are employed in the manufacturing process. The manufacturing facility performs extensive burn-in testing at every level of production, including component, subassembly, PC board, modular assembly and system level. Extensive investments in modern computerized test equipment guarantee highly reliable performance over long lifetimes under adverse conditions.

The latest laser-cutting equipment, micro-assembly processing equipment, wire-cutting and automatic test equipment using micro-processors are utilized to ensure uniform quality. All equipment is manufactured to the highest commercial quality standards with equipment performance and high equipment reliability being the proven result of the manufacturing process.

The Loral TerraCom engineering department is comprised of a group of outstanding design professionals. Areas of design expertise include analog, digital, video and microwave radio, and antenna design, as well as digital signal processing and multiplexer design. In addition to the electrical design capabilities, the engineering department also includes mechanical design, design/drafting, documentation and configuration control. Department capabilities are reflected in the consistent, proven qualities of the Loral TerraCom microwave radio and digital multiplexer products.

Loral TerraCom's main product line is the TCM-600/620 family of rugged, portable, frequency-agile, microwave transmitters and receivers. This equipment, which is in service worldwide due to its excellent reputation and market demand, is modular in construction, with full tunablity across each band in the range of 1.7 to 19.7 GHz.

TCM-600/620 — A Study in Advanced Engineering

Although the first TCM-600 microwave radio system was shipped late in 1971, the TCM-600 has set the trend for many of today's latest offerings by major microwave radio manufacturers.

Loral TerraCom's rugged 'blue box' offers flexibility unmatched by any other microwave radio. It is a wide-band FM radio with operational capability in any communication bands within the range of 1.7 to 19.7 GHz by replacement of plug-in RF modules. Operation from either 24/48 VDC, or 115/230 VAC (50/400 Hz), is possible, depending on which of plug-in power supplies is installed in the unit at the time. Additionally, it is capable of modular baseband reconfiguration for up to 2400 channels of FDM, various formats of television ranging from 525 line NTSC to 819 line high resolution, wide-band radar video, or data transmission. Depending upon the specific series of TCM-600/620 used, and the selection of data baseband modules, the TCM-600/620 will interface with any standard CEPT or Bell format up to 45 Mb/s.

It is the remarkable versatility, coupled with outstanding reliability, that has allowed telecommunications authorities, military forces and broadcasters of almost 40 countries to benefit from the unique expertise of Loral TerraCom's TCM-600/620 radio systems.

The TCM-600, in an astonishing number of optional configurations, has provided emergency restoration of communications services, and temporary services, in extremely harsh environments from well above the Arctic Circle to the sands of the Middle East. The same TCM-600, which has been selected by many NATO nations and non-NATO for tactical battlefield communications, is also an invaluable aid to countries with developing communication systems where versatility and high quality are of the greatest value.

Loral TerraCom has historically been a specialized product supplier, choosing to address areas which have been neglected by other microwave radio manufacturers. The major emphasis at Loral TerraCom has been on product flexibility and reliability, implemented by clever use of proven technology.

As the world around us continues to evolve, and the communications systems of all nations grow in response, Loral TerraCom looks to the future with confidence, and to every opportunity to be of service to the world of telecommunications.

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- Tactical field terminals
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Temporary Services
- During fixed link construction
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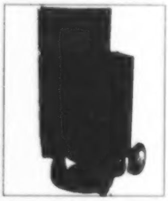
Features
- Modular radio reconfigurations:
  - — Frequency band
  - — Baseband
  - — AC or DC primary power
- Built-in test equipment
- Rugged, weather resistant construction
- Synthesized frequencies
- Tripod, tower or rack mounting
- Optional remoting of RF modules
- Optional protection switches
- Complete range of accessories

Capabilities
- Frequency coverage
  - — Tunable bands within 1.7-19.7 GHz
- Baseband selection
  - — Digital:
    Bell Standards up to 45 Mb/s DS-3
    CEPT Standards up to 34 Mb/s M3
  - — Telephony:
    Up to 2400 channels FDM
  - — Video:
    PAL
    SECAM, MESECAM
    NTSC
    Wideband radar

Rack Mounted

Duplex Field Configuration



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ADVANTAGE, SWEDEN!

WHO would have thought that a geographically large but sparsely populated country of eight million inhabitants located in Northern Europe could be a world leader in the field of telecommunications? That it would have the world's cheapest telephone services and highest telephone density; or that it would be part of the world's largest mobile telephone network and have a higher degree of computerization than any other country?

Televerket, or Swedish Telecom, is the governmental utility responsible for the management and maintenance of a network stretching from mainland Europe into the Arctic Circle! Its policy has always been to have a telephone network available to everyone at a low cost for the benefit of society as a whole. After all, no investment gives a better return in a country than telecommunications.

Whilst the telephone density is the highest in the world, at more than 90 per cent, there is also tremendous growth in data circuits and data networks. A boom is underway in the large 350,000 subscriber mobile telephone network covering the whole of Scandinavia and in many other new services.

Some years ago Sweden started its transition to a fully digital network and today more than 12 per cent of all lines are digital; not surprising when it is borne in mind that Sweden has more data terminals and circuits per capital than any other country in the world.

Looking to the future, Swedish Telecom's major target today is the 'Digital '87' project. 1987 will be the year when the subscribers of the major cities all over Sweden will be connected within an integrated switched digital network operating at up to 64 Kbit/s. This will be possible through optical fibre and digital microwave systems and high-speed (565 Mbit/s) digital systems on co-axial cable connecting all the main Swedish towns and cities.

Televerket's aim in the new Information Society is to provide an integrated services digital network (ISDN). Such provision has already started. At company level advanced systems are already in operation.

Swedish Telecom's management philosophy is based on the following:

☐ The importance of having highly trained staff in a good working environment.

☐ Decentralization and flexibility with few management levels throughout the organization.

☐ The employment of efficient technology and working methods. (The successful AXE switching system, for example, is the product of Ellemtel, a jointly-owned company of Televerket and L.M. Ericsson and typifies the type of equipment in use within Swedish Telecom).

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Swedish Telecom's window on the world is **Swedtel** (Swedish Telecoms International AB), a wholly-owned subsidiary. This company was formed in 1967 and through it the experience and expertise of Swedish Telecom is offered in the form of consultancy packages throughout the world. Indeed, there are few developing countries in which **Swedtel** has not carried out work.

Most **Swedtel** services are carried out in the form of projects which are tailor-made to the exact needs of the client — a telecommunications administration, a government or any other organization. On these projects **Swedtel** places great emphasis on the transfer of knowledge and close co-operation with the client.

SWEDTEL consultancy covers all aspects of telecommunications.

In some places **Swedtel** has been retained as a consultant to an administration. Some projects to be mentioned are, for example: a Middle East country, in which Swedtel was appointed in 1981 for the digitalization of a whole national network; the Gulf Region, where **Swedtel** has been performing consultancy work for the laying of submarine cable systems; and East Africa, where a training school has been set up with the help of **Swedtel** training experts.

Most **Swedtel** services are requested within the following fields:

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Operation and Maintenance

Tailor-made maintenance systems; operation management assistance in various areas including computerized systems for planning; network records; billing etc.

Marketing

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In co-operation with the Swedish Broadcasting Authority, **Swedtel** also offers consulting assistance in all aspects of broadcasting, including planning, systems design, management and training.

Swedtel has an experienced, full-time staff at its headquarters in Stockholm. These experts continuously update their knowledge of local conditions through extensive annual travel throughout the world. These staff are supplemented by recruitment from Swedish Telecom, **Swedtel**'s primary source of recruitment, whose policy it is to support the operations of **Swedtel**.

All staff are able to offer first-hand expertise based on real operating experience in one of the world's leading telecommunications administrations.

For more details, please contact:
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Mailing address: PO Box 3538, S-10369 Stockholm, Sweden Tel. +46 8 781 0520, Tx: 11707 SWEDTEL S, Telefax: +46 8 10 88 55, or our Subsidiary Company in London: Swedtel Ltd, Simpson House, Cherry Orchard Road, Croydon CRO 6BA, England, Tel: +44 1 686 7261, Tx: 9419609 SWEUK G, Telefax: +44 1 680 3473.

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Swedtel is a major consulting company in the telecommunications field. As an independent subsidiary of the Swedish Telecoms Administration, Swedtel gives unbiased advice in all areas of telecommunications.

Swedtel's goal is to give qualified assistance, leading to transfer of know-how and mastery of complex technology to our clients.

Since 1968 Swedtel has carried out more than 150 projects in more than 40 countries all over the world.

Swedtel provides consulting assistance such as:

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- Long and short term planning
- Systems design
- Technological strategies
- Preparation of technical specifications, tender documents
- Factory inspection, quality control
- Supervision of systems implementation
- Training of operation and maintenance personnel
- Management assistance and management training for telecommunications organizations

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A subsidiary of the Swedish Telecommunications Administration

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Developing World Communications

Every nation needs effective and continually improving telecommunications services.

In developing nations, improved telecommunications services are essential to sustain the economic life of the country while widespread, ready access to basic telephone service is necessary to fulfil social needs.

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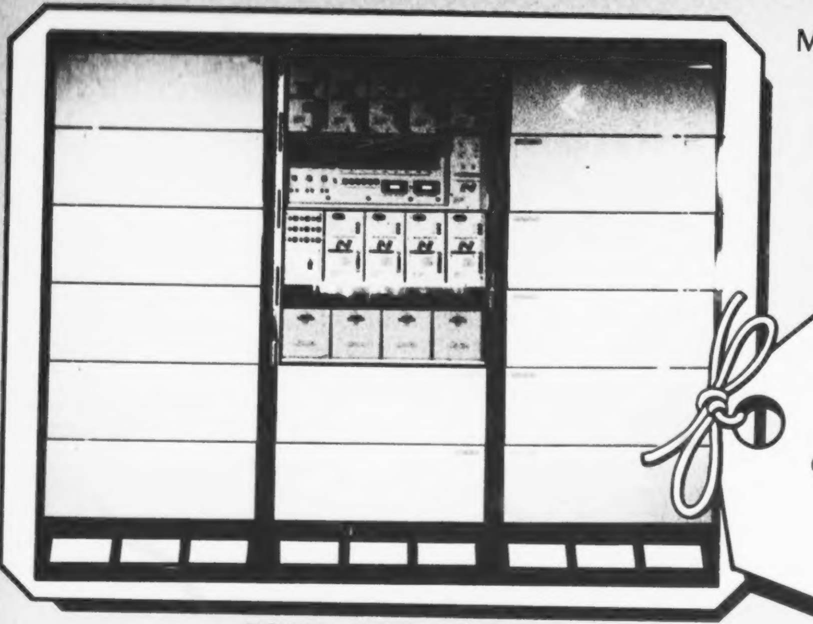

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INNOVATIVE RADIO ACCESSORIES BY MAGNUM

USE of the two-way radio has grown immensely over the past decade in both the public and private sectors world-wide. This important communication tool is now a standard item in a wide variety of job descriptions but in certain environments, no matter how good the radio is, reliable two-way communication is still marginal at best, and sometimes impossible!

The EM-200 EAR-MIKE was introduced in 1983 to provide, among other things, the means for good communication in harsh environments.

The Magnum EAR-MIKE works with most portable radios equipped for a Remote Speaker/Mic. It is a miniature device worn in the ear, which is both a speaker and a microphone. In receive mode, the EAR-MIKE is a conventioinal speaker earphone, but in transmit mode it becomes a microphone, and converts the minute vibrations in the ear canal during speech into signals for radio transmission. YOU ACTUALLY TALK THROUGH YOUR EAR!

With over 15,000 EAR-MIKEs in use, attached to 120 different models of two-way radio, the main beneficiaries are people who must wear a face mask, breathing apparatus or cover-all protective clothing during the course of their work. An external Push To Talk switch is mounted on the small amplifier module in such a way that it can be depressed through outside clothing, allowing the radio and EAR-MIKE to be worn under the clothing giving maximum protection to both units.

Communication in high noise environments is easily achieved by placing hearing protectors over the ears and EAR-MIKE. This blocks unwanted noise for the comfort of the user and allows clear two-way communication.

The EAR-MIKE is widely used by Police and Military Emergency Response Teams. It is also used by people who have need for discrete communication, because of it's ability to transmit even a whisper, while at the same time eliminating the loud bark that radios make when keyed.

The EAR-MIKE is extremely versatile, and is offered with a variety of options that make it comfortable to wear, hygenic for its user, and adaptable to almost any environment.

The current EM-200 is approved Intrinsically Safe for all I.S. radios in the United States, and by CSA in Canada for Motorola MX-300 and MT-500, and at time of writing,BASEEFA approval is close to completion. The EAR-MIKE is also I.S. approved in Australia.

SPECIAL EAR MIKES. The EM-200A was designed for airline ramp and maintenance personnel and plugs directly into most airline intercom systems. The EM-200W is for use with any sound powered intercom system.

NEW EAR-MIKE. In our quest to provide EAR-MIKEs for all levels of the market, we now offer the EM-150. This unit is functionally the same as the EM-200 but comes complete with a hardwire interface cable for the desired radio. This unit does not have military spec'd plugs, nor does it have Intrinsic approval which allows us to offer it at a lesser cost.

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HEADSETS. The line of headsets manufactured by Magnum offers users a complete range of choice from an ultralight weight set for low noise areas through an intermediate single or dual cup model to a high noise attenuating series, all built for maximum user comfort.

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Each portion of the system, either handset, module or interface cord, can be acquired as separate items, providing low cost and total flexibility when working with a multitude of different radios.

VEHICLE INTERCOM SYSTEM. For high ambient noise vehicle application, MAGNUM offers the MAGNACOM VEHICLE INTERCOM. The MAGNACOM was developed to address the need to provide clear communications in noise saturated vehicular environments. The system will interface directly with most two way mobile radios and provide VOX communication for two to six personnel.

Magnum is a Canadian based company with distributors in most major countries. For more information please contact: **Magnum Distribution Ltd.**, 102-11400 Bridgeport Road, Richmond, BC Canada V6X 1T2. Telephone (604) 270-1389. Telex 04-355889 (MAGNUM). Fax (604) 270-2138. □

MAGNUM

EM-200 EAR-MIKE™

"ALLOWS YOU TO TALK THROUGH YOUR EAR"

- A microphone that is worn in the ear and is also a speaker.
- Works with any two-way portable radio equipped with external speaker/microphone capability.
- "Push to Talk" button on interface module allows hands free two way communication.
- Worn under protective clothing, head gear, breathing apparatus, two-way communications is easily maintained.
- Ideal in high ambient noise environments — ear protectors shield microphone and speaker.

GOLD MEDAL
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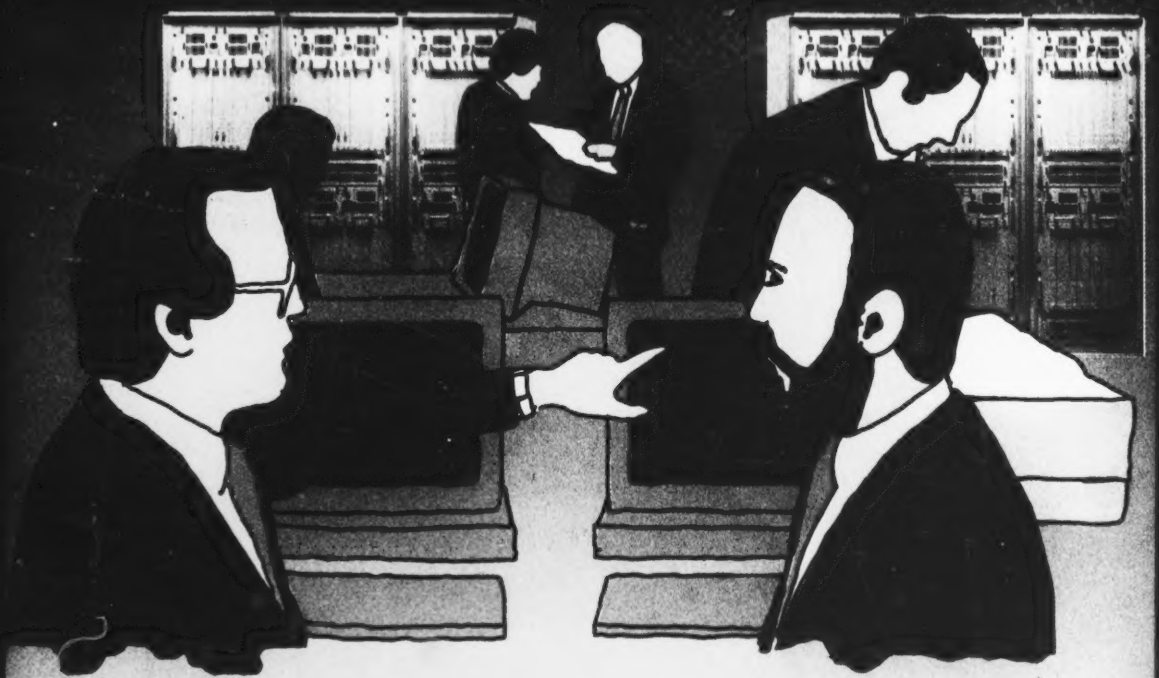
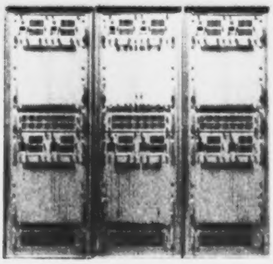
MAGNUM



Christian Rovsing, a member of ALCATEL NV. the second largest telecommunications group in the world, supplies military communications systems for

● Automatic Message Handling Systems (CR-AMS) ● Strategic & Tactical Networks



The CR80 Computer

The defense systems are implemented on the company's CR80 fault-tolerant computer, ensuring very high system availability, redundancy and survivability. The extensive *modularity* of the CR80 computer provides the customer with systems, which never become obsolete. *Expansion* from very small systems with a single CPU into very large systems containing more than 2000 CPU's and thousands of access lines is achieved merely by adding hardware modules and standard software to existing systems with no or very short disruption of operation.

Automatic Message Handling System (CR-AMS)

CR-AMS provides military customers with extremely reliable message handling facilities, using the military *ACP-127 message format* implemented by most nations in the Western world.
The message format has been adapted to the automated data processing environment and *requires no skilled signals personnel* to use.

The CR-AMS provides:

- Interactive dialogue between user terminals and computer
- Automated message handling
- Automatic Distribution
- Private data base for each terminal
- Global storage and logging of all traffic
- Multilevel security
- Dual password scheme
- Six message priority levels

Additional features

- Interfaces to public data nets
- Positive acknowledgement of message delivery
- Supervision and control
- Encryption
- Remote diagnostics

AMS systems are built to customer specifications. Complete systems are integrated and acceptance tested at the factory before installation in the field.

Site Support

Experienced engineers perform site support. Encrypted remote diagnostic dial-up links between customer sites and the factory will be established.
Diagnostic of faults and repair can be performed *without disrupting normal operation* of the system.

Training

Customer Personnel of all skill levels will be trained in maintenance and operation of the system.

For more information please contact

Christian Rovsing a·s
af 1984

Europe: Headquarters,
Christian Rovsing A/S af 1984, Lautrupvang 1, DK-2750, Ballerup, Denmark.
Telephone +45 2 65 11 44, Telex 35111 cr dk, Telefax: +45 2 65 43 74.

North America: CR Systems Inc.,
6655 S. Lewis, Tulsa, OK 74136, USA,
Phone: 918-747-6382, Telefax: 918-749-7656.

TELECOMMUNICATIONS MANAGEMENT

73

Above: *An earth station in Fiji: numerous studies have concluded that satellite transmission is the only affordable way of providing reliable voice and data communications between the islands of the South Pacific. Photo courtesy of Cable & Wireless.* ***Left:*** *An antenna under construction on the Cook Islands: the aim is to develop a network in which every island can communicate directly with every other island, thus avoiding two-hop transmission. Photo courtesy of Cable & Wireless.*

Table A: A Cost comparison for model network

STATION	MAIN CAPITAL COSTS IN US$ NO. OF TRUNKS	NETWORK INTELSAT	AUSSAT	PACSTAR	SPACE SEGMENT HIRE CHARGES IN US$ NETWORK INTELSAT	AUSSAT	PACSTAR
CAPITAL CITY	52	506,000 (156,000)*	480,000	365,650	88,400	174,000	43,300
ISLAND A	19	94,000	180,000	104,200	30,600	60,231	18,750
ISLAND B	7	61,000	110,000	54,700	11,900	23,423	7,292
ISLAND C	17	91,000	180,000	99,700	28,900	56,885	17,708
ISLAND D	7	61,000	110,000	54,700	11,900	23,423	7,292
ISLAND E	3	49,000	80,000	36,700	5,100	10,038	3,130
TOTALS	52	862,000 (512,000)*	1,140,000	715,650	176,800	348,000	97,464

* *If existing earth station is used*

LINKING THE ISLANDS

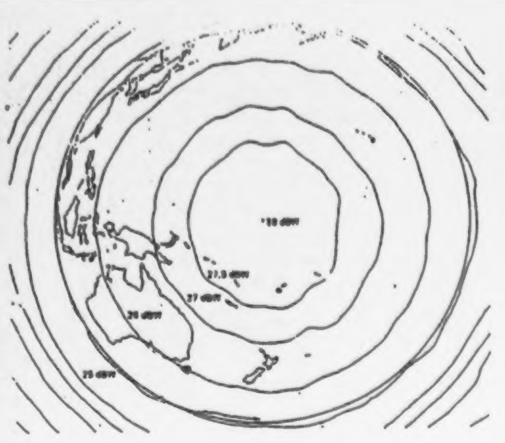
by E J Wilkinson

Telecommunications networks in the South Pacific are still very limited, with little over three out of every hundred people having access to a telephone. For the last three years, the South Pacific Telecommunications Development Programme has been studying ways of extending the network and of adapting it to cater for telegraph and data services and television as well as voice transmission. E J Wilkinson of the South Pacific Bureau for Economic Cooperation reports on its progress.

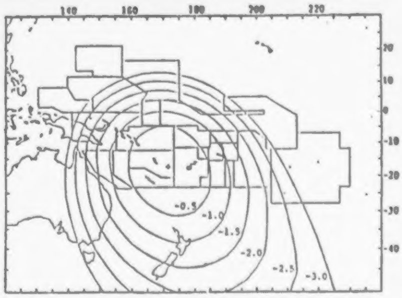
THE establishment of a regional management group to plan and coordinate the extensions and improvements to the telecommunications systems of the South Pacific Forum countries was an innovative concept of the governments of the region. Following the first meeting of the management group (a board of 28 directors – two from each of the South Pacific Island countries plus two each from Australia and New Zealand) early in 1984, and the appointment of a programme controller at the South Pacific Bureau for Economic Cooperation (SPEC) to direct the work between management group meetings, worthwhile progress has been made in the planning of the programme.

The aim of the South Pacific Telecommunications Development Programme (SPTDP) as set out in the original recommendations to the South Pacific Forum was to extend and improve the present telecommunications infrastructures to provide network-connected telephones to communities not yet enjoying such services. One quantification of the aim indicated a likely doubling of the telephones per 100 population from the present figure of three per 100 to a new level of six per 100.

Early in the planning stages it was realised that attention could not be restricted to improving the rural networks alone, and that growth in rural subscribers would lead to the need to improve and extend the urban networks. Some microstates drew attention to



INTELSAT V



AUSSAT K3

Beam centre is 36 dBW for 30W and 31.5dBW for 12W transponder

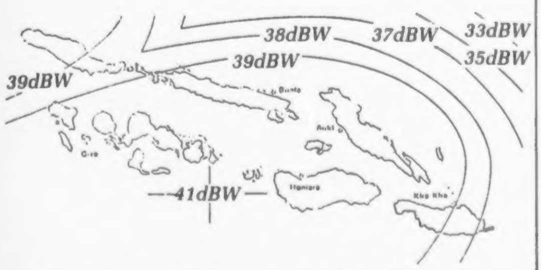


Fig. 1 Coverage Contours for South Pacific

PACSTAR

C Band Regional Coverage

the impossibility of identifying separate rural and urban networks in their countries.

The main emphasis of the programme was to be the provision of telephone services. However, two forms of non-speech traffic, which appeared almost from the beginning of the SPTDP planning, are worthy of separate discussion.

Telegraph and data services – Although not originally considered to be a large percentage of the total service requirement, the telegraph and data service demand can be seen to be growing. An important element of the data traffic is 'electronic mail' where the delivery of private correspondence by electronic means to remote communities without regular air or shipping services is clearly an important service even if it is not highly profitable at the outset.

The gradual adoption of computer methods in the South Pacific is also generating intercomputer traffic and the capability of the new transmission systems (particularly satellite networks) to provide low cost point-to-multipoint services is generating demands for one-way and two-way information access systems. Many of these demands are for specialised services in the fields of education (led by the University of the South Pacific Distance Teaching Network), meteorological forecasting and warnings, emergency health care, marketing, inter-country news, etc.

Television – While not identified as a high priority in the original recommendations for the establishment of the regionally coordinated SPTDP, requirements for television services have arisen almost from the outset. As a result of concern from some countries that telecommunications developments may fail to provide for television uses – particularly in the case of the establishment of satellite small earth terminals for outer island telephone traffic – the 1985 South Pacific Forum Meeting directed the management group of the SPTDP to include the planning of the reticulation of television programmes, wherever possible, within its telecommunications planning work. The August 1986 Forum meeting endorsed proposals for the establishment of a SPEC committee to allow television issues to be discussed between member countries.

It is a little over three years since the SPTDP initiative of the South Pacific Forum was begun. Prolonged discussion and negotiations regarding the funding of the programme has limited progress on the implementation of the new telecommunications facilities, but worthwhile progress has been made in the planning of the methods to be used. Complete success has been achieved in the use of the unusual programme management method adopted and all participating countries are working within the management group with a friendly cooperative spirit to solve not only their own telecommunication development needs but to help in finding solutions for those of their regional neighbours.

The many detailed studies of telecommunication requirements in and between the small island nations of the South Pacific over recent years have all concluded that, because of the archipelagic nature of the area, the only affordable method of providing reliable trunk circuits between the islands would be to use satellite transmission methods.

By the mid 1980s all but two (Tuvalu and Niue) of the 12 Forum countries had been provided with international connections through the Intelsat Pacific satellite(s) and attention was being directed towards the extension of satellite methods to cover national as well as international services.

As mentioned above, the establishment of the South Pacific Telecommunications Development Programme focused attention on rural services and intensified the search for affordable satellite solutions for the low density telecommunications traffic to the outer islands of the region.

Three available, or proposed, satellite network options offered by Aussat, Intelsat and PacStar have been subjected to very detailed investigation. This culminated in presentations by the three bodies to a meeting of the management group of the SPTDP at which each quoted the capital costs and space segment hire charges involved in serving a 'model' network in which a capital city hub station serves five outer island locations. The qualifications set down in the model include:

☐ capital costs are radio equipment only on a FOB (free on board) basis;

☐ all space segment channels are permanently assigned.

A summary of the costs presented to the meeting is shown in Table A. The coverage offered by the three networks is shown in Figure 1.

After studying the information provided, especially the operational features and costs, the management group has reached some broad conclusions:

☐ That any satellite space segment facility offered for use in a South Pacific network must be available for use on both national and regional connections.

This critically important requirement (which had not been so positively identified in the case of some of the earlier domestic/regional satellite networks such as Palapa, Arabsat, etc.) results from the very low traffic densities in even the largest of the South Pacific countries, such as Papua New Guinea and Fiji, and the still lower density of call traffic in the smaller countries.

If the charges for the hired satellite space segment are to be covered by the income from the calls (at tariff rates which the public of the South Pacific can afford), the channels derived within the hired satellite transponder(s) must be shared between all earth stations in the region and be capable of use for both regional (inter-country) and domestic (within-country) connections.

It must be accepted that regional traffic is international traffic and thus 'institutional' difficulties arise in setting up and operating a joint national/regional satellite network in the case of some south-west Pacific countries.

The fact remains, however, that the most desirable design aim for both economic and technical reasons is to evolve a satellite network for the Forum countries (and possibly near neighbours) within which every island of any country can establish direct connection through the same satellite with every island of every other country, and thus eliminate two-hop transmission.

This requirement has been established in the main with telephone traffic in mind, but is no less important in the case of non-speech traffic such as telegraph and data services and in distributing television and sound broadcasting programmes within the South Pacific.

☐ Implicit in the view that any satellite network adopted for the South Pacific should provide for both national and international connections, is the intention to concentrate the traffic offered to the satellite transponder through a demand assigned multiple access (DAMA) controller in order to minimise the number of minutes per day that the common pool of hired channels is unused. The converse of this statement is perhaps more important, namely to hire the minimum number of trunk and international channels necessary to handle traffic offered from a large number of subscribers on separate islands of separate countries and at an acceptable grade of service.

From examples studied by the SPTDP, reductions to as little as one fifth of the optimised permanently-assigned channels for a grade of service of .01 may be possible. Such savings are critically important in establishing the viability of satellite connections to the smaller centres of population which must be served over long water paths.

The issues which must be investigated further include:

☐ the study of recent developments in DAMA systems where lower cost controllers, with distributed control logic, enable the 'all eggs in one basket' problem to be minimised. Time division systems to replace frequency division multiplexing (FDM) analogue have also been developed and studies of several new products are required.

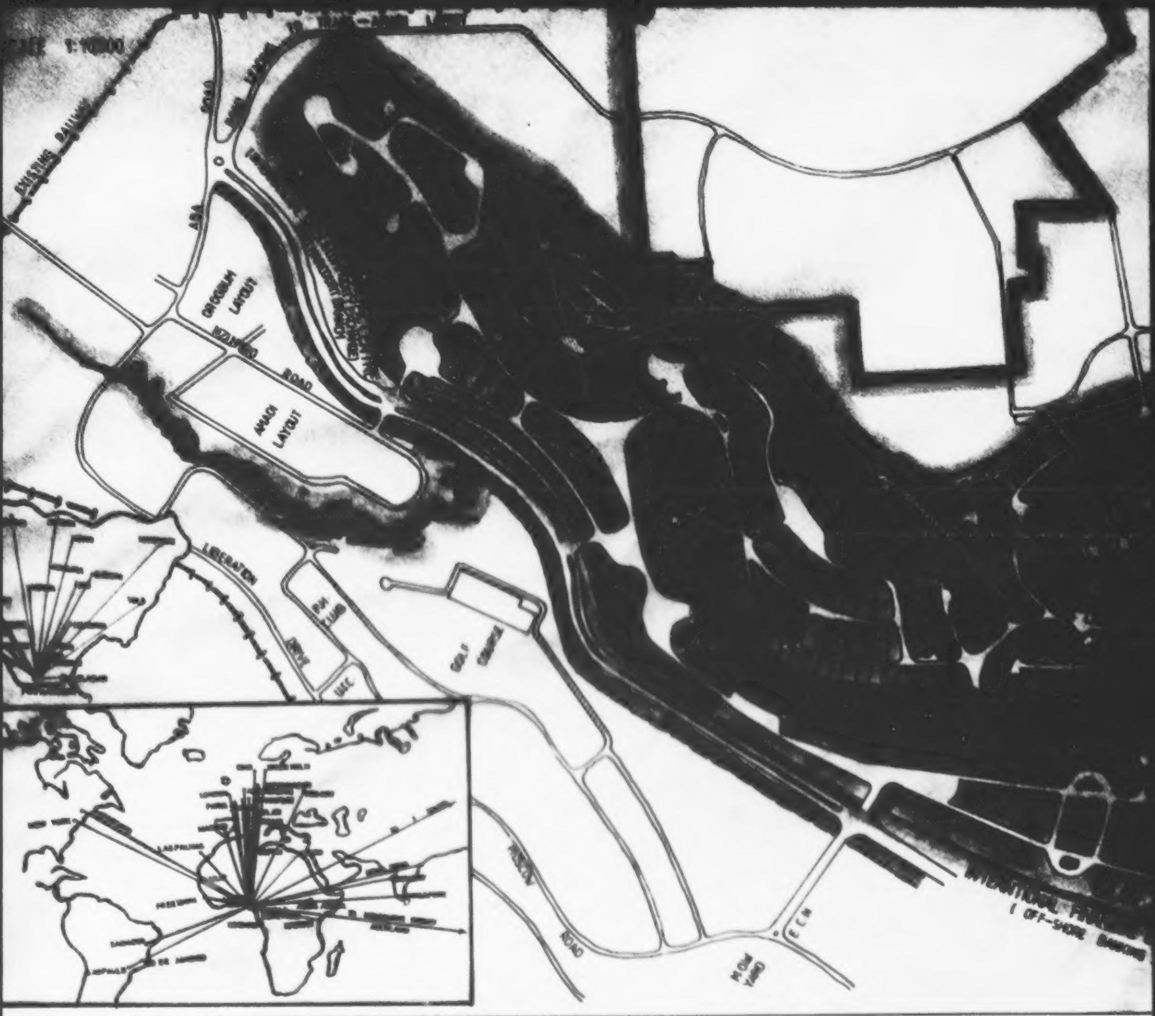
☐ the issue of sharing space segment channels and, particularly, sharing ownership of a regional DAMA facility, raises policy questions in the telecommunications sector of the participating governments which need to be addressed. The financial attractions of regional DAMA operations are so compelling that the present institutional barriers should not prevent further discussions and negotiations from proceeding.

☐ the figures quoted in the PacStar presentation demonstrate the potential savings in capital and recurring costs from use of an optimised network (with spot beams to achieve high effective isotropic radiated power (EIRP) transmissions from the satellite and high receive sensitivity in the case of the uplink path).

Evidence from Canada and Australia with similar spot beam designs demonstrates similar cost savings. The SPTDP mnagement group has also heard that future Intelsat networks will incorporate features such as spot beams for regional networks to compete with non Intelsat networks. The Intelsat presentation includes a network architecture based on Intelsat V-A satellites (1987-89 time frame) where subnetworks are operated with DAMA control to achieve optimisation without resorting to spot beams and permitting all south-west Pacific national and regional traffic to be achieved from the hire of one transponder.

Further studies on the optimisation of network design by taking advantage of developments in switching topology and the use of spot beams are now required if the most cost-efficient regional satellite system design is to be achieved.

This presentation will differ from the 'user' type plans previously prepared in that it will attempt to incorporate projections of national, regional and international traffic flows for the 12 South Pacific countries and will also provide some estimates of non-speech traffic densities and directions of flow. ☐



TELEPORTS: A GROWING PHENOMENON

by Chief Adebayo Adeleke

Economic activities have always needed a centre: first sea ports, then rail ports and airports. The latest development, a reflection of the importance of telecommunications to today's society, is the teleport. Chief Adebayo Adeleke, Chairman of the Africa and Middle East Region of the World Teleport Association, describes the enormous potential of this phenomenon and its particular relevance for developing nations.

JUST OVER two years ago, a report entitled 'The Missing Link' was released by the Independent Commission for Worldwide Telecommunications Development, in which the necessity for balanced and universal growth of telecommunications throughout the world was emphasised. The report highlighted the gross inadequacy of telecommunications services in the Third World, and the need for the governments of the industrialised nations and people of goodwill in the private sector to cooperate with their counterparts in developing countries in finding urgent solutions to the perennial problem of poor telecommunications services, particularly in Africa, the continent with the worst record.

Arising directly from this report, the International Telecommunication Union (ITU) organised its 1986 Forum in Nairobi, Kenya, which

RESIDENTIAL AREA
SPORTS CENTRE
LANDSCAPE AREA
EXISTING CREEK
EXISTING RAILWAY
EXISTING ROADS

Above: *Proposed layout for one of the ten teleports planned for Nigeria.*

devoted attention almost entirely to the search for practical solutions to Africa's telecommunications problems. Here the Secretary-General of the ITU, Richard Butler, announced preparations for carrying out a feasibility study for satellite telecommunications coverage of the whole of Africa, the report of which should be submitted to African governments in January 1988. He further stated that the study would take account of recent telecommunications studies carried out by various regional economic groups in Africa based on the existing terrestrial networks and exchanges or switching stations. These networks and switching stations are, however, antiquated and therefore incapable of taking full advantage of the potential efficiency of a modern satellite telecommunications system, as and when satellite coverage is provided.

Below: ***Teleports could have particular value in developing countries as sophisticated telecommunications centres able to connect rural areas with the outside world. Photo courtesy of Seditas.***

Economic, scientific and technological observers have expressed the view that the Information Age has taken over from the Industrial Age. John Naisbitt, author of the bestselling *Megatrends* says that by the turn of the century 'about 86 per cent of the workforce will be gathering, processing and disseminating information or will be providing services to each other and services related to information tasks'. Demographers have also predicted that new job openings in information related activities between now and the year 2000 are estimated at 60 million.

History has shown us that economic activities grew around sea ports, followed by rail ports (railway stations). More recently, airports have become the driving force and focal point of economic growth. Necessity being the mother of invention, the 'Information Age' has now produced a new centre of economic growth – the teleport. This is a natural response to meet the needs of a modern well-informed 'information society', a society which relies increasingly on computers as well as on rapid, accurate, reliable and cost-efficient communications.

The teleport is a newcomer into the telecommunications world. Its main components are:

☐ a radio frequency interference-free antennae farm,
☐ a fibre optic and coaxial cable network,
☐ a telecommunications control centre, and
☐ an integrated real estate development.

It acts as a sophisticated telecommunications centre through which users can transmit and receive voice, data, facsimile, video and other types of communications services via satellite as well as through terrestrial networks. In the same way as sea ports or airports receive and distribute people and goods, teleports receive and distribute telecommunications data and information. Operating on the principle of overlay and bypass, the teleport system is capable of taking full advantage of any type of satellite to achieve efficient delivery to its users through modern fibre optical networks or other appropriate networks. There are currently about 200 teleports either operating or under development around the world.

Numerous satellite and terrestrial communications networks converge at a teleport communications control centre, which is usually located adjacent to the antennae farm. From this control centre, long-distance or intra-city systems, regional or local distribution systems, and national and worldwide communications systems are routed to intra-building or intra-complex communications systems, such as local area networks (LANs), or 'smart' or 'intelligent' building systems throughout the area which the teleport is designed to cover.

Computer aided designs (CADs) can be easily transmitted from major cities and industrial centres throughout the country via a teleport to computer aided assembly and manufacturing (CAM) facilities at a nearby industrial zone. The teleport can also assist in cost-efficient computerised inventory control for the enhancement of CAD/CAM processing, which makes it possible to assemble or manufacture spare parts at competitive prices with a skilled labour force. The presence of such enhanced communications systems is an incentive for industry to locate in a teleport-aided industrial zone.

A teleport should be capable of providing access to more than one regional or local network. It should also be able to provide inter-connectivity between networks as well as over the 'last mile', and be able to provide users with access to many different carrier networks.

The ideal teleport must be designed to provide, in a single location, the most reliable, most comprehensive and best communications and data processing facilities and services available at the lowest cost. It should be able to be connected with a variety of satellite and terrestrial communication networks – digital, analogue, microwave, fibre optic, coaxial and traditional copper cables.

The presence of a teleport in a regional area will have the effect of concentrating a variety of communications users into a single 'user pool', thus making it possible for large and small companies alike to obtain all the advantages and benefits previously enjoyed by only a very limited number of multinational corporations. Members of the 'user pool' could thus obtain route diversity options and the security of back-up route redundancy which would not have been practical for a single network.

The teleport should be designed to meet the needs of companies and enterprises which have large communications and information processing requirements, such as financial institutions like banks, insurance companies, building societies and brokers.

Other potential users are reservation related businesses, such are airlines and hotels, billing and data processing operations such as utility companies, and broadcasters and publishers. Last, but by no means least, are multinationals with branch offices scattered around the world, which will benefit immensely by relocating a 'back office' branch or centralised telecommunications division within a teleport communications centre.

Ideally, there should be sufficient flexibility for the teleport to adapt easily to new technologies. For example, fibre optic systems aside, there are several new long-distance services which depend on a mix of new technologies, such as the Equatorial Communications Satellite Company's network, which links computer terminals by using small satellite dishes that can send and receive data and thus totally bypass telephone lines. Furthermore, several American firms already connected to teleports are planning to build nationwide paging networks that would allow individuals carrying beepers to receive signals anywhere in the country; at present, paging systems are restricted to short distances, usually within metropolitan areas.

In addition, a teleport should be able to provide ships on the high seas with all their telecommunications contact both offshore and ship-to-shore.

The teleport has gained significant recognition in the world of broadcasting because it lends itself to centralised location for the transmission and reception of television and radio signals. Among the principal advantages of a centralised location are a shared labour/maintenance force, multiple access and concentration of programming, and a common location for the utilisation of 'fly away' earth stations.

Clearly, the teleport is a new phenomenon, with a vast and, indeed, incalculable potential. Disappointingly, however, more attention has been given to specific technologies than to the interaction of technology with the fundamental organisation of work, time and space in urban society. The latter is very necessary because the size and importance of a city is determined by the amounts and kinds of information flowing into and out of it, and by the way it is interconnected with other cities in the national and international network of information flow.

In its contribution to finding solutions to the 'Missing Link', the World Teleport Association (WTA) has as its principal objectives the promotion and development of teleports throughout the world. For this purpose, the world has been divided into four regional areas: WTA–Asia/Pacific, WTA–Europe, WTA–Americas and WTA–Africa and Middle East. The last region, with its headquarters in Lagos, Nigeria, has the most challenging task to perform in the face of a rigid monopoly of inefficient communications services. This is in contrast to the other regions which have considerably better services and where this monopoly is rapidly being removed to allow for greater private sector participation, such as the Americas with the United States in the lead, Asia/Pacific with Japan in the lead, and Europe with the United Kingdom leading and many other European countries in varying states of deregulation. Currently the United States leads the world in teleport development with about 80 teleports under development or in operation, followed by Asia, where most of the teleports are concentrated in Japan, and Europe, where involvement is widespread.

The initial efforts of WTA–Africa & Middle East, in cooperation with the Association of African World Trade Centres, are being directed towards those countries which have begun to accept the principle of free enterprise with greater private sector participation, and are carrying out structural adjustment programmes (SAPs) in line with the recommendations of the World Bank and the IMF.

One such country is Nigeria, where the teleport concept has been accepted by ten of the 19 state governments who have agreed to provide land for the development of teleports in their states. This is a first step towards transforming communications services in Nigeria in a way that would dramatically increase telephone penetration from the present dismal level of 0.03% per cent, as against 30 per cent to 50 per cent in the newly industrialising nations and 90 per cent to 98 per cent in the industrialised nations.

The Nigerian and other teleports in Africa are being promoted by African Teleports (AFTEL) Ltd. Their aim is a high level of service, research and development, teamwork and control, systematic growth and efficient management. The teleports can be connected into the government PTT (NITEL) network and, in addition, users will have direct access to or from international and national contacts because of overlapping of satellite footprints which serve North, Central and South Americas, Europe, Africa and the first hop of the Asia-Pacific Basin.

Every building in the central business districts within the teleport coverage areas (i.e. office, residential, showroom, medical, educational, recreational, entertainment, hotel, conference centre, etc.), the export free zone of Nigeria, sea and airports, railways and major industrial centres will have access to fire and police stations, security monitoring, paging, teleconferencing, electronic mail, videotex, high resolution graphics distribution, computer facilities and networks, entertainment and service networks, CAD and CAM facilities, among others. It is expected that the teleport system will eventually become a major state telecommunications facility complementing the existing NITEL facility.

Apart from Nigeria, WTA–Africa & Middle East and the Association of African World Trade Centres are aggressively promoting the establishment of teleports in other African and Middle East countries.

The potential benefits of teleports for developing countries in particular are obvious. By using special radio, such as cellular radio, which can easily interconnect to teleports, efficient telecommunications services can be provided to thousands of subscribers in rural areas, such as farmers, local government councils, agro-industries, forestry establishments, agricultural extension officers, etc. The system can support both mobile traffic or fixed station telephony, the latter generally being used by rural business or residential customers as it requires more channels than mobile traffic.

In practically every developing country which recognises the strategic value of agriculture and agro-allied industries, this sector of the economy is being given high priority in economic development programmes. The full realisation of these depends largely on the availability of efficient rural telecommunications services. This is where the teleport system has a major role to play.

In conclusion, the teleport communications system is highly recommended to both developed and developing countries, but especially to the latter where there is a desperate need for upgrading of telecommunications services and networks. However, in most of these countries rigid government PTT monopoly does not give room for private sector participation as an alternative source of capital to augment meagre government resources for the provision of efficient telecommunications services. The longer the monopoly is maintained, the longer telecommunications services will remain undeveloped. □

Above: *Much of the knowledge and skill needed to operate and maintain modern switching equipment can be learned through on-the-job coaching. Proper training ensures that telecommunications equipment is used to its full potential.* **Below:** *Basic skills, such as cable splicing, can be taught in a laboratory before the trainee receives on-the-job coaching and perfects his knowledge by experience.*

TRAINING BRIDGES THE TELECOMMUNICATIONS GAP

by Brian Tickle

New technology can transform the potential of a telecommunications network in a developing country. But all too often lack of management and operational expertise detracts from the benefits of such investment. Equipment alone will not solve the problems. Brian Tickle, Deputy Chairman and Chief Executive of Bell Canada International Inc., stresses how training at all levels can pay high dividends.

THE accelerating advances in telecommunications technology have the potential to reduce, and eventually eliminate, the wide disparities in telecommunications services throughout the world. That potential is often not realised, however, because managerial and operational skills are lacking.

Products of the new technology which has ushered in the telecommunications revolution can be a boon to telecommunications in developing countries. Digital switching and transmission systems, for example, require less capital investment, in real terms, than earlier types of equipment that are still in use in parts of the telecommunications networks in developed countries.

Digital equipment is easy to maintain and operate, as long as managers and technicians are properly trained, and can provide services of greater variety and flexibility than is possible with older types of equipment. With older types of systems, for example, circuit rearrangements demanded hard-wiring changes. Now they can be done by altering software with a few strokes on a keyboard.

The new technology can thus enable a less developed country to leapfrog from a less-than-adequate to a state-of-the-art system, and some telecommunications administrations have done just that. However, the adoption of advanced technology has not been an unqualified success in every case.

There is a sad scenario that has been enacted repeatedly in developing countries. A telecommunications administration stretches its resources to purchase advanced equipment from abroad. After the installers have gone home, the painfully heavy investment does not perform to its full potential. There is disappointment.

This stems ultimately from the telecommunications administration's lack of managerial and operational skills to use the new equipment to the best advantage. Administrative personnel have insufficient knowledge of their function; technicians are not adequately trained; and, most significantly, managers do not have the expertise to establish control systems and to manage the entire network as one integrated system.

Although perhaps less frequent today than in the recent past, a similar pattern of events has occurred all too often, amply demonstrating that technology alone does not ensure good telecommunications services or economic operation.

In realising the objective of every telecommunications organisation – the provision of services when, where and as the subscribers want them, and at affordable prices – the human factor is paramount. Technicians must understand their equipment; clerical and other employees must know their jobs; and managers must know how to integrate the entire operation so as to fulfil the demands of the market in a cost-effective way.

There is probably no telecommunications investment which can yield as high a return as that made in training those who are called upon to manage and operate the telecommunications system. That training needs to be as advanced and forward-looking as the new, state-of-the-art equipment.

Often an opportunity to reorganise a telecommunications administration and retrain personnel coincides with a major programme of expansion and improvement of the system as a whole. However, even when no major expansion or upgrading of the network is contemplated, a sound training programme, especially for managers, can yield important dividends and sometimes dramatic results. Existing equipment can be made to produce a better service, for instance, simply because the keys to operational efficiency are improvement in management systems, the use of sound operating practices and the training of personnel.

The view that the training of executives and managers is crucial to the success of telecommunications organisations is one shared by the Canadian telecommunications industry and the Canadian government. Faced with a clearly perceived need in developing countries for people trained in modern telecommunications management skills, members of the Canadian industry and the government have established a non profit-making centre for training executives and managers from developing countries, called the Telecommunications Executive Management Institute of Canada (TEMIC).

All major telecommunications operating companies and equipment manufacturers in Canada and the relevant governmental ministries have collaborated in establishing and funding the institute. During the formative period of TEMIC, the International Telecommunication Union encouraged their initiative and contributed valuable advice.

Besides enhancing the knowledge and skills of executives of telecommunications authorities in developing countries, TEMIC is intended to serve as a forum for the exchange of experiences and ideas. Common problems and concerns will be reviewed under the tutelage of telecommunications professionals and joint solutions developed. The institute is expected to broaden the understanding of the importance of telecommunications management among the authorities of countries who send students, and that increased awareness should lead to increased national development.

The curriculum, designed to attract decision-makers, is of a high quality. The first class – for executives – begins in the summer. Later, middle- and lower-level managers will participate in the programme and, eventually, selected technicians. Some 240 students are to be trained each year.

The sponsors of the institute believe that the training of leaders of telecommunications organisations in developing nations can produce the greatest benefits in the shortest time. Improvement and expansion of telecommunications networks in developing countries is seen as creating a major market for telecommunications equipment and increasing international telecommunications traffic. Ultimately, this should bring an increase in world trade and international understanding. Improved telecommunications will spur the economic development of nations in the southern hemisphere and enhance their social and cultural activities.

There is ample evidence that technology

transfer – or, more precisely, knowledge transfer – is feasible. And cross-cultural knowledge transfer succeeds when the training agency is sensitive to the host culture.

In 1982, the Trinidad and Tobago Telephone Company, commonly called Telco, decided to embark on a major expansion and improvement programme which called for the installation of digital systems throughout Port of Spain and the surrounding area. Telco seized the opportunity to implement consultants' recommendations to reorganise the company and completely overhaul its operations. Telco engaged Bell Canada International, a consulting company with experience in 70 countries, to ensure that the new equipment would go into service with minimal disruption and that the expanding network would serve the maximum number of customers as quickly as possible and in a cost-effective way.

Throughout the programme, the consultants were involved in every aspect of operations, and worked alongside their Trinidadian counterparts. At the same time, a comprehensive training programme was conducted – in classrooms and on the job; at home and abroad. The consultants' advice and assistance touched on everything from fundamental planning, implementation planning, network synchronisation and planning to financial management. It included the billing system and collection procedures; auditing and security; management of customer demand; material control; vehicle maintenance and control; forecasting and business development; outside plant construction and engineering; human resources management and development, and various other areas.

Training included basic skills, such as splicing, installation, repair, transmission and business office procedures, as well as coaching in scientific management and the use of computerised management tools. Throughout the programme there was emphasis on accurate record-keeping and the establishment of systems to make results-tracking easy and fast. An effort was made to stimulate productivity and achieve optimum benefits at minimum capital cost and operating expense.

The expansion programme, extended to include the entire country in 1984, is virtually complete, as is the restructuring of the organisation and the associated training programme. The results of the four-year effort are impressive:

☐ the number of lines in service has increased by more than 230 per cent;

☐ the number of employees per 1,000 lines has declined to 19 from 45, and is expected to reach a level of 15 this year;

☐ despite more than doubling the size of the network, the headcount remains almost unchanged;

☐ revenues have increased by more than 600 per cent and the company realised a profit for the first time last year.

☐ The quality, reliability and accessibility of telecommunications services in Trinidad and Tobago now rank among the best in the Caribbean and Latin American regions. The consultants are no longer there and Telco's network is managed and operated by Trinidadians. Technology transfer has been successful.

Another practical demonstration of successful technology transfer is in Saudi Arabia. The amazing growth and improvement in that country's national telecommunications system which has occurred during the past decade is well known. When Saudi Arabia launched its massive expansion and modernisation programme for telecommunications at the end of 1977, the Kingdom depended heavily on outside experts in the management, operation and maintenance of the system. Barely 20 per cent of middle and senior managers in Saudi Telecom were Saudi nationals.

Today, as a result of a large-scale training programme, conducted in parallel with the expansion and modernisation programme, more than 80 per cent of middle and senior managers are Saudi nationals. Foreign consultants who, at the beginning of the programme, had active, managerial roles, now serve Saudi management as advisors. Again, there has been a successful transfer of telecommunications knowledge.

Technology in the form of equipment is relatively easy to export from an industrialised country to a developing country. The specific training to operate a particular apparatus or a particular system can often be obtained from the supplier. However, the kind of expertise that does most to turn technology into telecommunications services cost-effectively is that of executives and managers who need to direct and coordinate operations as an integrated system.

The export of this managerial and operational expertise is much more complex than the export of, say, a vehicle, an air-conditioner or a digital switch. Knowledge gained elsewhere and procedures developed in another culture must be adapted to the host culture, not simply 'plugged in'. Experience proves that knowledge transfer can be achieved, however, and that it can pay high dividends in terms of telecommunications efficiency, national development and human betterment. ☐

TELECOMMUNICATION DECISIONS FOR TOMORROW

by Eric Jamieson

Setting up or expanding a telecommunications network involves a whole chain of inter-related decisions – about investment, equipment, services and personnel. Yet as the scope of the telecommunications industry widens, the choices available become increasingly baffling. Eric Jamieson, Marketing Manager of Ferranti Industrial Electronics Ltd, stresses that potential growth, flexibility and financial considerations must be taken into account if these decisions are to be valid.

TELECOMMUNICATIONS is an essential feature of the infrastructure of every country, whether developed or developing. New telecommunications services are becoming available not only from the traditional PTTs but also from private organisations following the international trend towards liberalisation in the field.

New telecommunications equipment is also becoming available at an almost alarming rate, in order to meet the demands of the new systems suppliers and, through them, the changing needs of domestic, business and military users worldwide.

In view of this growing *embarras de richesse* of telecommunications equipment, there is an urgent need for all users, and particular the PTTs of developing countries, to have the experience and expertise to make the complex planning decisions necessary to ensure that growth goes hand in hand with flexibility and economy.

Planning for growth is essential. Experience shows that the provision of new services tends to produce an increase in usage beyond what might have been forecast from a formal market research exercise, and this should be allowed for in any forward planning. One of the earliest predictions in the information technology field, for example, was that 'the foreseeable computing needs of the world would be met by no more than 10 computers'. Similarly a senior member of IBM is reported to have forecast that 'computers will never prove to be a profitable element of this company's activities'. And even today the planners underestimated the potential of cellular radio.

But if it is essential to plan for growth, it is equally essential to plan for flexibility, i.e. the ability to integrate equipment obtained from competitive suppliers, within the same network, over a period of at least a decade.

The telecommunications field is wide in many respects. Geographically, it is more than worldwide in that it includes exra-terrestrial satellites as well as every country and continent. Topographically, it includes everything from snow-capped mountains to arid plains and tempestuous areas of sea. It is also wide from the point of view of the number of services it has on offer: for the domestic user, business user and the military user; and for each type, there are services for handling speech, text, data and video images. These include the public switched telephone network (PSTN), telex, teletext, high speed data networks, facsimile, electronic mailbox, videotex, audio conferencing, video conferencing, message switching, circuit switched networks, packet switched networks, paging, cellular radio and cordless telephones.

Correspondingly, the list of equipment available is positively legion. Table 1 illustrates, at least partially, the wide variety available on the world market; and when it is remembered that there are tens of manufacturers for each type of equipment, the need for system flexibility and worldwide standardisation and inter-connectivity becomes clear. To take one example, the manufacture of telephone handsets, there are at least five British manufacturers, 10 German manufacturers, six French manufacturers and many others in Italy, Sweden, the Netherlands, Belgium, etc., not to mention the North American continent, the USSR, Japan and a number of Far Eastern countries. A similar situation arises with PABXs, VDUs and keyboards, and it is essential for telecommunications services providers in developing countries to ensure that the basic trunk services, local networks and customers' equipment are all compatible.

Historically, national PTTs have conformed to International Consultative Committee on Radio (CCIR) and International Consultative Committee on Telegraph and Telephone (CCITT) standards in order to provide their international communication services and national trunk service. Not all terminal equipments bought on the world market are compatible with each other, however, and a major responsibility for any service supplier is to ensure that all equipment ordered is compatible with both existing installations and with future plans. It needs to be flexible enough to allow for future increases in the number of subscribers, and improvements in the quality/speed or type of service being provided.

Planning is also essential for economic reasons. In general, competition is the keynote for economy. Single sourcing almost always involves extra costs and restrictions with regard to flexibility and growth. On the other hand, a blind belief in competitive tendering can lead to short-term savings at the expense of long-term cost-effectiveness. It is important that for those elements of the telecommunications system that have a long life, e.g. the trunk network, including overland and submarine cables, microwave radio relay systems and exchange equipment, full account is taken of the lifetime cost as distinct from the initial capital cost.

Such judgements are not simple, and it is crucial that within developing countries there is a cadre of well-trained engineers capable of taking the decisions necessary for the expansion of the national networks and the provision of new telecommunications services. □

Below: *The range of available telecommunications equipment.*

	acquisition	**transmission**	**switching**	**processing**	**presentation**
speech	telephone (carbon) (electronic) microphone recording machine	HF microwave radio equipment (fixed and mobile) Coaxial cable Satellite systems Optical fibre Magnetic tape	Circuit switching Packet switching PABX equipment	Modens Multiplex equipment	telephone loudspeaker
text	telex fax word processor				telex fax printers VDU
data	keyboard sensors transducers computers point of sale terminals				VDU display boards (flap boards)
video	video camera				VDU television screen

ENCOURAGING EXPERTISE

by Dr George Newns

Increased competition and commercialism within the telecommunications industry have brought an appreciation of the crucial need for high-quality managerial and technical training facilities. Dr George Newns, Business Development Director of British Telecom Overseas Division, stresses the benefits for both industrialised and developing countries.

THE telecommunications industry is probably the most rapidly expanding and changing business in the world today and, although difficult to quantify, few would dispute that there is a close parallel between the pace of economic growth and the development of communications.

***Left & above:** The prime objective of both management and technical courses is to provide experience which will be directly relevant to the student's own environment.*

But there is, too, a growing gap between the pace of telecommunications development in the industrialised world and that in developing nations. The reasons for this are legion but surely in no one's interests. There is, therefore, a strong case for a reappraisal of the situation with a view to narrowing the gap.

There is no doubt that the improvement and expansion of telecommunications systems worldwide would serve the common interest of industrialised and developing countries alike. However, governments are generally reluctant to invest in telecommunications while they have other pressing infrastructure requirements.

At a time when scarce hard currencies may be needed to obtain prime necessities such as food and medical care, how can the purchase of modern telecommunications equipment be justified? After all, many countries do not possess a telecommunications system capable of offering even a rudimentary service, so why invest in one kind of advanced technology rather than another? These questions were addressed by the Maitland Commission at the international conference in Arusha in May 1985 which proposed various ways of improving the situation.

There is, alas, strong evidence that the key role which telecommunications can play in economic and social development is not sufficiently appreciated at the highest political levels in some countries, although it is encouraging that some of the largest developing countries such as China and India have publicly identified telecommunications as being particularly important and are making positive progress in implementing improvements.

For the benefits of better communications to developing nations are not only restricted to their contribution to the economic well-being of a country. Effective telecommunications can also serve vital social needs such as education and a low-cost means of linking remote areas with urban centres encourages self-reliance, contributing to national cohesion and reinforcing the infrastructure.

One of the great achievements of the 20th century has been the development of international communications, linking the world either by satellite or submarine cable with agreed international standards to provide a coherent global system. The real question is how to build on this network by improving and expanding the national networks of the poorer countries so that they can also obtain the full benefits of the new age of information technology.

Although the major problem facing poor

Right: *Modern training techniques, such as interactive video, make it possible to provide better instruction in a shorter time than with earlier methods – a virtue which is especially appreciated in developing countries where financial resources are low.*

countries in expanding their networks is shortage of foreign currency, there are other constraints due to management styles and organisation. There is no fundamental reason why a national telecommunications company should not be a profitable business. Many national telephone companies, however, are part of their country's civil service structure and are thus constrained from expanding to meet market requirements and operating as a business concern. Furthermore, the changes of structure, organisation and attitudes needed to move from a bureacratic environment to a commercial business are not easy.

Take British Telecom, for example. Its formation and privatisation was the result of a thorough reappraisal of the part which government should play in the development of a national telephone service, which was then part of the Post Office. The reappraisal clearly concluded that the management of the postal and telecommunications businesses should be separated.

At the same time, the equipment supply sector of the telecommunications market was liberalised for open competition. This was followed by privatisation and the sale of over 50 per cent of the ownership of British Telecom to over two million shareholders, many of them private citizens.

Such a complete transformation from state-owned monopoly into a publicly held company operating in a competitive environment is a new phenomenon, and one which has aroused considerable interest in many countries. Governments and telecommunications operators the world over are now recognising that a new approach is needed if the benefits of the communications revolution are to be obtained quickly.

Investment in telecommunications is not cheap, as assets must be maintained and managed properly over a period of many years if they are to make an economic contribution. There is thus a strong case for establishing a telecommunications organisation which is financially independent of government funding or, at the very least, requires less financial aid from government than hitherto. And it is unlikely that the path taken in the United Kingdom is necessarily the single solution for every situation.

A few telecommunications operators around the world have long been in private ownership, while others remain public corporations or government departments. What is clear, however, is that investment in equipment and training will not be forthcoming if the telecommunications organisation is not run efficiently and commercially.

Indeed, in its preparation for privatisation, British Telecom (BT) had to make many changes, including the development of new management structures. The skills required to run a commercial business contrast significantly with those needed to administer a government department and the key benefits of commercialisation have been in the fields of finance and new standards of management.

The comprehensive training facilities that BT has developed to meet its own needs can now help to bring about the standards necessary to improve telecommunications services in developing countries. Many overseas administrations have long made use of British Telecom's knowledge and expertise by sending staff on a wide variety of training courses held in the United Kingdom, and it was to help meet the growing requirement for specialist instruction that the British Telecom Training Liaison Agency (BTTLA) was established in 1982. Today this service is part of BT's Overseas Division, which has been introduced to provide the marketing channels for the developing world to tap the resources of the company.

In addition to taking responsibility for the UK training of all overseas personnel, BT has helped in the development of courses and training schemes designed for the specific needs of overseas administrations. These cover English language, technical programmes, integrated digital network training, training for instructors and management training.

Technical training is essential and BT has its own Technical College comprising six establishments in various parts of the country. Skilled instruction in subjects as diverse as injection welding and computer maintenance is provided in well equipped buildings, some of which include residential accommodation.

The importance of training in management skills is also vital and recent BT experience in this field provides a blueprint for other countries. Customer awareness and care, financial and marketing expertise, together with a host of other skills, have been found by BT to be essential if the benefits of commercialisation are to be realised.

***Above:** Training often proves to be self-financing as course graduates return to their own countries to train others.*

A high percentage of overseas students selected to attend BT courses are sponsored and many Commonwealth countries make use of the facilities. The development of advanced training techniques (including interactive video programmes) has also broadened the appeal. BT has taken a lead in the development of a European approach to training, maintaining a close liaison with telecommunications schools on the Continent to ensure that overseas students do not receive conflicting instruction.

Adopting a listening, learning and liaising policy, BT's experienced college staff have learned the importance of considering the role of students before placing them on a particular course. A general approach to course planning has been rejected in favour of relating instruction to the equipment and system with which the student is familiar.

Cultural considerations are also taken into account; some students may have a resistance to handling machinery (such as interactive video for example), while others may have only a limited knowledge of the latest telecommunications technology and may need extra tuition.

There is no pressure to pass a formal examination because the prime objective of the management course is to enable the knowledge and experience gained to be applied to the student's own environment. The amount of technical knowledge imparted is a matter for fine judgement, because it is BT's experience that skills in personnel management and finance can be of greater value to those destined to plan networks.

The increasing sophistication of equipment makes for fewer technical faults, and, therefore, there is a tendency for a reduction in the requirement for craft skills. The well-trained manager, however, will bring an 'expert systems' approach based on his systems knowledge, using checklists to determine the cause of a problem.

BT's Management Training programmes have become a standard by which other training courses are judged, and it is common for graduates to maintain contact with the BT College on an informal basis for many years after they have received instruction. In fact, training often proves to be self-financing as those trained by BT return to their own countries to train others.

In many cases, advanced training techniques developed to meet BT's own needs have been adopted by overseas administrations. A video disc featuring marketing, for example, has been exported to several countries which believe that the lesson has a universal application. BT has found that by the use of modern training techniques it is possible to provide better instruction in a shorter time – a virtue which is appreciated in most countries.

While there may be a wide disparity between the type of equipment and size of network operated by developing countries in comparison with BT, the skills required by today's telecommunications managers and engineers tend to be much the same in all countries. In each case, management must be able to move with technology as it changes – something which BT has found easier to face as a commercial company than as a state-owned corporation.

At all events British Telecom maintains a strong desire to help improve telecommunications in other parts of the world and so narrow the gap that exists between the industrialised nations of the world and less developed countries. To that end it will continue to play an important role. □

VALUE FOR MONEY IN DEVELOPING COMMUNICATIONS

by Robin Dudney

Faced with a multiplicity of products, telecommunications customers in developing countries must aim for a good balance of reliability and low costs in their purchases. Above all, they must find manufacturers able to meet their particular needs. Robin Dudney, a director of TanTech Ltd, a company providing marketing and management services to the telecommunications industry, and of Lake Electronics (UK) Ltd, puts the case for the small supplier.

MECHANICAL equipment delivered to a tropical country utilises lubricating oils formulated to a different specification from equipment designed for use in sub-zero temperatures. This obvious statement demonstrates the usual response of a manufacturer to the differing requirements of the markets which he is trying to penetrate.

If the design engineer is to provide his management with a sensible return on its research and development budget, he must create a product which is saleable into the largest selection of markets. His success in achieving this will determine the fortunes of his company for the lifetime of the product which he is designing, at present usually considered to be over three years.

Is this policy valid and if so what about those segments of the market which are not targeted? Is it reasonable for a manufacturer to isolate himself from a portion of the market? The telecommunications industry worldwide has capacity to spare and as well as winning business from its competition, all suppliers should be pursuing objectives which enlarge the market.

Good marketing theory exhorts the planners to identify those segments of the market in which it wishes to trade through sound market research which defines, amongst other things, the principle factors affecting the buying decision. The planner is restricted in time and money and researches in depth only those markets which are big enough to attract his early attention and likely to give him a profitable return. The marketing specification which results is therefore for a product which may be extremely successful in terms of its profit capability, but which is targeted on a segment of the market chosen for its current earning capacity and no other reason.

The telecommunications industry is dominated by the 'big' companies, whose marketeers target the large markets leaving the little ones to be tackled by the salesman who needs to find some extra revenue. A biased view, perhaps, but would any company build its marketing strategy around a plan to penetrate the smallest markets?

According to a UNESCO study there is an extreme imbalance in the availability of information and communication facilities worldwide, a situation which can only be improved through international cooperation.

90

Must we wait this long or can we find sufficient common ground between what the customer wants and what the supplier can provide to increase the rate of growth of the smaller markets?

It has long been recognised that industrial development is closely tied to a country's communications infrastructure. More recently, a decisive indicator of the degree of development of a nation has been its telephone density. Again, according to the UN, the objective to be achieved in expanding the communications infrastructure in the rural areas of developing countries are:

☐ a telephone located no more than one hour's walk from any of the people living in the area;

☐ a public call office for every 10,000 inhabitants.

These minimum requirements may shock the planner who is used to stretching out his hand for a phone and it may seem technically straightforward to supply a small number of telephones to be used in a remote region. However, the transmission problems to be solved are large, particularly if the electrostatic conditions are upredictable. There is also a debate as to whether the telecommunications technology appropriate to industrial countries should be employed. And if there is disagreement over using modern technology in the cities of developing countries, its use in rural areas is presumably contested even more strongly. There is a natural progression of population from the rural areas towards the greater prosperity of the cities. World bodies encourage the telecommunications industry to provide equipment and services which will meet the needs of rural society and, by aiding it to improve its standard of living, help to reverse population movements. To achieve this, the equipment supplier must recognise the following:

☐ extreme climatic operating conditions;

☐ an erratic and sometimes insufficient power supply;

☐ compatibility with existing public systems;

☐ the cost of connection to the public network being greater than that normally incurred in more densely populated areas.

These factors, coupled with a reasonable expectation of negotiating in his own language or in English, French or Spanish with a supplier who is sensitive to his needs, will provide a customer in a developing country with sufficient to begin a discussion. But who does he begin it with? Depending on his historical affiliations and previous relationships with telecommunications suppliers, it is likely to be companies in Britain, America,

Below: *Technicians must be electrostatically earthed through wrist straps when installing and servicing equipment.* ***Bottom:*** *Design and presentation are becoming increasingly important in modern telecommunications products: larger companies invest a great deal in materials and quality research which tends to push up prices.*

CALLSWITCH 70

France or Sweden. Names which readily come to mind are AT & T, Northern Telecom, Siemens, Ericsson or Thomson and Alcatel. Yet is there a contradiction in expecting the requirements of a small market to be met satisfactorily by the output of these gigantic corporations? Clearly they can provide the broadest product range, but surely the products provided have been designed to satisfy markets with different requirements.

The past five years have seen a dramatic change in the structure of the telecommunications industry worldwide. Government activity in Britain, for instance, has been aimed at increasing competition through the granting of licenses to more than one network operator and through the liberalisation of the supply of equipment, all under the control of a regulatory authority. Among the beneficial results of this policy has been the creation of a number of smaller equipment suppliers which now compete with the well established and larger companies such as Plessey, GEC, STC and Philips. The growth of these smaller companies has been through niche marketing and the use of available technology rather than through the development and sale of state-of-the-art systems. These companies now seek other markets similar in size to the niches which they currently serve and many developing countries will find themselves targeted.

Sales managers in all companies are judged on their ability to achieve revenue and profit objectives. In the larger companies, they discharge this responsibility by selecting those opportunities from their order forecasts which can be closed for the highest price and the lowest cost. If an opportunity is big enough, bid teams will travel from their home base solely to develop that opportunity. The smaller entries in the forecast are pursued because 'the salesmen are in the area', or through agents.

The smaller company can afford to concentrate on perhaps two overseas markets as well as its home market. For the remainder it must use agents, supported by rare visits from company personnel. The smaller company has a need to be even more efficient than its larger competitor and seeks to concentrate its efforts on those customers where the technical requirement matches its skill. Once it has established this, it can press its advantages over the larger companies in several ways:

☐ faster replies to queries due to shorter decision-making processes;
☐ greater flexibility in design and manufacturing practices;
☐ lower overheads;
☐ less rigid commercial terms.

These advantages may be reduced by restricted financing which limits the company's ability to undertake unfunded pre-contract development work. But even this apparent restriction can be to the company's advantage, forcing it to be innovative and to make the most of the equipment which it has already designed.

Smaller companies have the potential of providing a lower-cost solution in a shorter time than their bigger competitors when trying to meet the requirements of developing countries. The difficulty is to bring customer and supplier together. Companies of less than $15 million turnover cannot sustain sufficient marketing campaigns to tackle the developing nations and, despite their suitability in meeting the customers' needs, they are unlikely to be visible.

The practice of distributing tender documentation internationally has helped small companies to acquaint potential customers with their activities. Even so, this is often completed without any knowledge of the unwritten conditions surrounding the request to bid. However, the increasing ability of the business world to communicate through facsimile and data transmission allows the customer and potential supplier to exchange some of this additional information quickly and this increases the chances of a smaller company being successful. Twenty years ago contracts were written on four sheets of paper. Now they are rarely less than 25 pages when all the annexes are included. Two of the many factors responsible for this increase in complexity are quality and reliability.

There is an old adage which says that quality and reliability are remembered long after the price is forgotten. Recognition of this truism drives manufacturers continually to seek improvements in both disciplines – an objective which should continue to hold a position near the top of the priority lists of company managers.

A system's reliability is affected by its design and by the way in which it is built. Larger companies make extensive use of materials research and large-scale integration to name but two areas which contribute to improved reliability. This extra expenditure is ultimately paid for by the customer through a higher allocation in the sales price. In addition, the reliability criteria and quality assurance procedures in many large companies are determined by the need of the principal customers for proof that appropriate standards are being met. This adds further to the price of a product.

The smaller company, without the benefit of the extra research, may lag behind the larger company in achieving higher reliability. His selling price will be lower, however, and the customer must weigh this advantage against the prospect of lower reliability.

Given these options, the customer needs to carry out a detailed study into the lifetime costs of each product to determine which one gives him the best value for money.

These can be calculated from a complex equation containing variables which differ from market to market. It is dangerous to draw general conclusions as the factors for each country may well be very different. The cost of installing a small exchange in an industrialised country, for example, where many outlets from the network are conveniently placed, is lower than the cost to install a similar product in a rural area of a developing country where the nearest outlet is miles away. The cost of labour is much higher, however. The time taken to recover an item for repair in a developed country is less because of the shorter distances involved, but the hourly cost of the labour is higher.

As an example, it may appear attractive for a developing country to purchase a product at $1,000 rather than a more expensive product at $1,200, but if the field reliability and the field life expectancy of the cheaper product is also less, the cost advantage in the purchase price soon disappears when all costs are taken into account. Alternatively, if the cost of repairs is cheap, then other factors may dominate the equation and the less reliability alternative emerges as having the lower lifetime costs. Most of the factors which make up lifetime costs are contained in the checklist in Table 1 **(Right)**.

In assessing lifetime costs and the contribution of such elements as reliability, the telecommunications operator in a developing country has an advantage over the administrations in America and Europe, for example, where the complexity of such calculations are huge, due to the diversity of the participants. Simplification is a benefit and the cost which the customer is prepared to pay for a defined improvement in reliability can be negotiated with a supplier if the latter is able to achieve it.

With increasing competition, each unit of cost in a product must be defined and earned. There is a place in the world telecommunications market for the smaller supplier, and the willingness of customers to work with these new companies will be more than repaid through the speed with which products can be brought to the market and the focus which can be applied to individual cost elements. In this way, smaller companies can contribute to enlarging the market and thus discharging their responsibility to society. □

Table 1 Factors determining lifetime costs.

product purchase price

period of warranty

type of warranty (repair or replacement)

cost of installing and commissioning

cost of training technicians

cost of field technician's time including idle and travelling time and transport

cost of components

cost of holding spare products to replace faulty units in the field

cost and ease of repair in the field

cost of holding components as spares

cost to recover product from field reflected by distance and terrain to be covered

field reliability of product – mean time between failures

field life expectancy of product – when will its useful life end?

cost of money – compare costs now with costs incurred in years to come

Note: Other factors such as the cost of repair facilities and test equipment may be ignored if they are the same for all products.

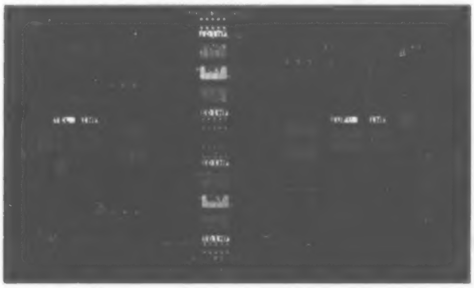
Real-time computer analysis of network performance: the control centre personnel is presented with a current picture of the network status, based on a continuously updated database. Warning of major network failures is given on an overview screen, thus eliminating unnecessary attention to individual equipment alarms.

NETWORK MANAGEMENT: CUTTING COSTS THROUGH MONITORING AND MAINTENANCE

by T W Engelhart and Tom Mares

The need for large-scale computer based network management systems is growing as the size and complexity of today's telecommunications systems increase, especially where maintenance resources are limited. What had before been a non-revenue producing item has now become a 'revenue protection' necessity. T W Engelhart and Tom Mares of Datap Systems, a division of the Canadian Swan Wooster Engineering Co Ltd, outline the main elements of a progressive monitoring and maintenance system which could prove valuable to developing networks.

Below, left and right: *Colour graphic video displays provide sufficient information for the control centre to put restoration plans into effect when a system failure has been detected.*

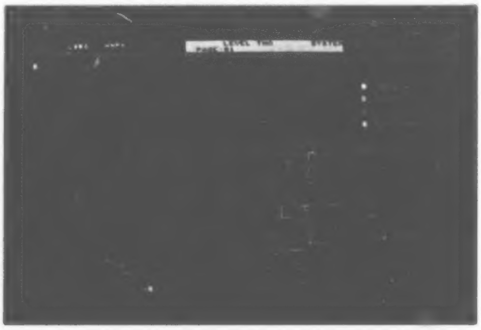


IN early telecommunications equipment designs, several functional parameters were combined into resulting minor/major alarm indications which were made available for remote monitoring. The escalating manpower costs associated with the operation of large and growing networks demand remote monitoring of transmission and switching network elements down to the card or functional module level. This trend generates a requirement where one network control centre is needed to handle hundreds of thousands of performance parameters. Due to the large number of monitored parameters, incoming data must be processed by a computer and the resulting information has to be presented to the operator in an intelligent condensed form so that he or she can have an instant overview of the network.

Network management concepts

The major objectives of network management can be defined as follows:

- to minimise congestion;
- to employ fully the under-utilised portions of the network;
- to minimise service and revenue loss due to network failures; and
- to optimise the rate of return on the network's capital resources.



There are many less ambitious definitions which, in practice, lead telecommunications operating companies to use a phased-in approach. Decomposition of network management objectives results in implementation of tasks or subsystems.

Advanced performance monitoring

Advanced performance monitoring is characterised by the following features:

☐ real-time computer analysis of a network performance. Based on a continuously updated database, the control centre personnel are presented with a current picture of the network status.
☐ rapid identification of major network failures. This eliminates unnecessary attention to individual equipment alarms, giving the control centre the information needed to put restoration plans into effect.
☐ an effective man-machine interface using colour graphic video display terminals that quickly present the overview data required for intelligent decision-making, combined with historical data logging, minimises manual record-keeping, resulting in a virtually paperless system.
☐ a powerful real-time database definition and management system that allows interactive relational database definition and easy application program access. All records are available to the display process for graphic or textual representation. This flexible, online, user-controlled database allows a generation of periodic management reports on network performance.
☐ hierarchical computer configurations with built-in redundancy, accomplished by means of database transfers from primary to standby computers or between levels.
☐ structural hierarchical design of both hardware and software, which facilitates the application of distributed intelligence through the network.

Interface to network elements

In the case of analogue telecommunications networks, trouble indications are made available by means of dry contact alarm/status outputs and limited use of analogue variables such as output transmit power. Since the majority of new digital network elements have a built-in intelligence, they are performing their own health monitoring with a serial output being available for outside indications and subsequent processing.

Due to the lack of adherence to certain standardisation efforts and general unavailability of efficient protocols, each manufacturer typically supplies his own standard. The resulting variety of interface requirements to the network elements generates a need for protocol converters or site information processors at locations equipped with a number of network elements from different suppliers.

Regardless of the source of the trouble indication or its format, there is a need for minimum primary intelligence to be embedded in failure messages as follows:

☐ severity of the failure;
☐ failed equipment unique identification;
☐ differentiation between service – affecting and non-service affecting area;
☐ differentiation between network element failures and incoming signal failures.

In addition to the alarm surveillance data, advanced network management and control requires maintenance messages consisting typically of the following categories:

Performance monitoring – usually consists of interrogation of network elements for stored or real-time generated performance data such as errored seconds, severely errored seconds, unavailable seconds, bit error rates, number of slips, etc. Some of the performance parameters may have to be calculated externally from primary indications provided by the network elements.

Remote control – allows the remote activation of network element functions such as exercise switch, restart processor, switch to protection, etc. Efficient protocol is required for real-time verification of remote control action.

Failure isolation – typically provides remote testing and interrogation to allow diagnosis of a section, line, equipment, etc. In switching systems, messages may allow the software trouble detection and isolation.

Database management of network elements which allows down-line loading of data such as threshold parameters, filtering tables, mapping information for digital cross connects, etc.

Network maintenance management

A comprehensive and integrated approach to network maintenance management is the key to achieving the stated objective for modern network management facilities, namely to 'minimise service and revenue loss due to network failures'. Maintenance of telecommunications facilities is an integrated part of operations and, therefore, any computer based support must be highly integrated into an overall network management concept.

Automatic interfaces to network surveillance and performance monitoring are essential for rapid identification, prioritising, scheduling and correction of network failures. In addition, ties to facility records, mapping and financial systems are critical for efficient and cost-effective maintenance management.

Maintenance activities

In general, the sources of network maintenance activities fall into four major categories:

☐ trouble tickets;
☐ subscriber service requests;
☐ call before you dig (CBYD) advice; and
☐ performance test results.

Trouble tickets are generally issued as a result of facility outages detected by network surveillance systems associated with the individual elements of the network, or problems detected by technicians in the normal course of inspections and performance monitoring. The volume of such tickets, although small compared to other sources of maintenance activity, has a significant impact upon network services. Therefore, the accuracy of the fault diagnosis and speed of dispatch is essential to maximise the service level and resulting revenue.

Typically, a large volume of **subscriber service requests** is received through 'call takers', who must validate, prioritise and clarify the requests. They must handle the service orders and complaints with partial and sometimes conflicting data. In order that these requests can be administered in an efficient and cost-effective manner, service records must be up-to-date and accessible, supporting both current and historical data.

In populated areas of North America, contractors are encouraged to advise the utilities of any activities which may affect underground services. To facilitate this a **call before you dig (CBYD)** policy has been established which, by means of 'one call' agencies, receives contractors' calls and forwards them to the affected utilities. With the increased use of fibre optic cables carrying large numbers of circuits, with typically no route redundancy, more attention must be paid to the CBYD data. There are more than 100 'one call' agencies in the United States and it is not unusual for large telecommunications companies to receive tens of thousands of these calls per week.

The data from these agencies does not adhere to any standard format, therefore must be individually and manually screened to validate those that require dispatch. It is not unusual for companies to dispatch personnel on 20 per cent of the CBYD tickets received and then only to find that 20 per cent of those were, in fact, necessary dispatches. To handle such a large volume of tickets cost-effectively, without running undue risks, requires accurate, up-to-date and readily accessible detailed mapping data of all outside plant facilities.

Preventive maintenance of the network is provided by means of **automatic access and test equipment**, which can facilitate the location and diagnosis of deteriorating performance of major network elements. Extensive and regular use of such equipment is a key to forestalling costly outages.

Cost of maintenance

It is not uncommon for network maintenance to represent up to 30 per cent of a telecommunications company's operating budget. In addition, losses in revenue and customers due to network outages and poor services can be significant.

In the competitive markets which have developed since deregulation, service has sometimes been compromised in an effort to reduce operating costs. Additionally, studies have shown that, on average, a maintenance technician is only 30 per cent effective. Given these facts, and the overall cost of maintenance, it is clear that reducing operating costs while still striving to improve service can be two mutually compatible goals. The key is increased efficiency and reduced outages through the use of advanced maintenance management systems.

Improvement opportunities in maintenance management

Traditionally, maintenance has been treated as an inescapable overhead – administered at a district or even site level – with little attention to the economies and efficiencies which can be achieved through regional co-ordination and computer-based information and planning facilities. To date, most computer facilities have largely been employed to fulfil a single function at a local level, thereby being unable to take advantage of the efficiencies of co-ordination with other network management functions or the economies of scale which can be achieved through regional based systems.

The key to improvement is fast and accurate access to large volumes of complex data with the ability to view this information from various perspectives simultaneously by various users.

Most of the information required for maintenance management of large telecommunication networks can be grouped into five logical categories:

☐ routine inspection programmes;
☐ maintenance work orders;
☐ work order history;
☐ facilities information; and
☐ parts inventory information.

A comprehensive programme of inspections and regular automatic access and performance testing is vital to minimising inadvertant outages in telecommunication networks. The computer database provides the ability to forecast labour, materials and other resources required to implement the programme and ensures strict adherence to these programmes and procedures.

By far the greatest opportunities for improvement are in the area of maintenance **work order management** (i.e. trouble tickets and service work requests). Managed maintenance must consider the conflicting requirements and priorities imposed by the operations and financial goals of the company, while considering the availability of resources. This is a complex scheduling formation which requires accurate information and the ability to track work in progress periodically so as to manage maintenance force assignments efficiently and cost effectively.

Completed work order data (historical) is an invaluable source of information for performance tracking of the maintenance management effort. Effective use of such information can provide the following:

☐ a basis for estimating future work orders by analysis of past experience on similar work;
☐ repair/replace analysis related to specific facilities;
☐ cause/effect analysis on troublesome or repetitive repairs; and
☐ identification of new inspection programmes.

There are four major categories of facility data, namely:

☐ facility/component/part hierarchy data;
☐ manufacturers' specifications (i.e. model number, capacity, size, etc.);
☐ outside plant mapping records; and
☐ subscriber cross connect records.

The data is best organised in a logical manner by area, facility, elements and parts of the element. With this organisation, maintenance activities can be related to the facilities to be maintained in an unambiguous and logical way, thereby minimising wasted effort by field staff in identifying, locating and reporting their assignments.

Spare parts inadvertently play a key role in managed maintenance providing vital information on:

☐ spare part specifications (i.e. number, description, manufacture, equivalents);
☐ where they are used (i.e. cross reference to the installed assets, facilities or elements); and
☐ quantitative data (i.e. stock location, receipts, issues, usage, etc.).

By using the information outlined above effectively, many opportunities present themselves for improving the quality and cost-effectiveness of network maintenance over the traditional manual approaches. These can be summarised as follows:

☐ rapid, reliable and accurate detection of faults;
☐ clear and unambiguous diagnostics;
☐ management of conflicting priorities;
☐ scheduling and dispatch;
☐ tracking of progress; and
☐ analysis of faults and their resulting repairs.

By taking advantage of these opportunities, management can realise higher revenues, improved availability of network facilities and a lower maintenance cost resulting from a better application of maintenance resources.

Characteristics of an advanced network maintenance management system

Advanced network maintenance management systems are characterised by the following major features:

☐ on-line interactive access to a central database by authorised users.
☐ integrated national, regional, district and local user support.
☐ direct interface to the network surveillance and control system to initiate automatic trouble ticket creation.
☐ direct interface to automatic mapping and administrative planning systems to facilitate CBYD and service work order validation and management.
☐ trend analysis of traffic volume, service work orders and CBYD for force management planning.
☐ direct interface to automated fleet management and computer-aided dispatch systems.
☐ employee time analysis with an interface to payroll and other human resources systems.
☐ budget development and planning based on trend analysis and variance reporting on actual performance.
☐ downline loading of 'preplans' to digital cross connect switches.
☐ knowledge based (i.e. expert system) software support.
☐ fourth generation languages.

Conclusion

This article has outlined major concepts in the recent developments of advanced network performance monitoring and maintenance. Many progressive operating companies are in the process of implementing a number of the functions described. Recent experience with installed systems in North America has shown up to 20 per cent reductions in operating costs with dramatic improvement in network availability. ☐

MAINTAINING NETWORK PERFORMANCE

by Paul Blakemore

The variety of testing equipment available for telecommunications networks is now enormous, ranging from the earliest regenerator fault location techniques to the latest methods used for qualifying the suitability of circuits for carrying speech or data. Paul Blakemore, Senior Product Manager, Telecommunications, of Marconi Instruments Ltd, reviews the field, with particular emphasis on PCM primary multiplexes and digital lines.

Above: *Line code and frame word errors can be monitored by the Marconi Instruments Digital Line Monitor 2833A to give an indication of local and overall performance and some degree of fault localisation.*

TECHNIQUES for supporting digital networks have been well established for many years. Introduction of higher and higher bit rates and optical fibre technology has added to the complexity and range of support equipment needed. In addition, data is coming to form an increasingly large proportion of the traffic carried and this in itself puts higher demands on the network in terms of error performance.

As developing countries will be most concerned with pulse code modulation (PCM) primary multiplexes and digital lines during the early phases of development, this is the main focus of our review. But, for the sake of completeness, there will also be some mention of higher order multiplexes and line systems.

Primary multiplex – analogue access

Traditionally, links between primary multiplexes are dedicated, i.e. switching is done at the analogue level after demultiplexing. This is the standard method of terminating PCM lines at analogue exchanges. The introduction of digital switching, where the switches accept primary level streams at 2048 kilobits/second (kb/s) and switch at 64 kb/s, means that some primary multiplexes can be redeployed to help expand the network. It also influences the type of tests and accuracy of measurements that need to be performed. Non-dedicated links means potential compatibility problems between multiplexes from different manufacturers, and consequently a need to specify half-channel performance more stringently.

In-service measurements

In-traffic testing can be performed only if unused channels can be identified and isolated for test purposes. In operational systems this is quite feasible, and different administrations have adopted various methods for achieving this. Thus it is quite possible to envisage systems whereby automatic access to unused channels is achieved for preventive mainte-

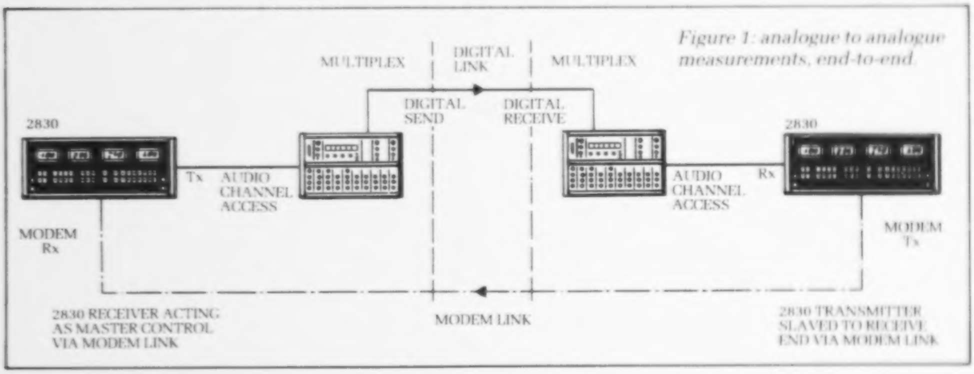


Figure 1: analogue to analogue measurements, end-to-end.

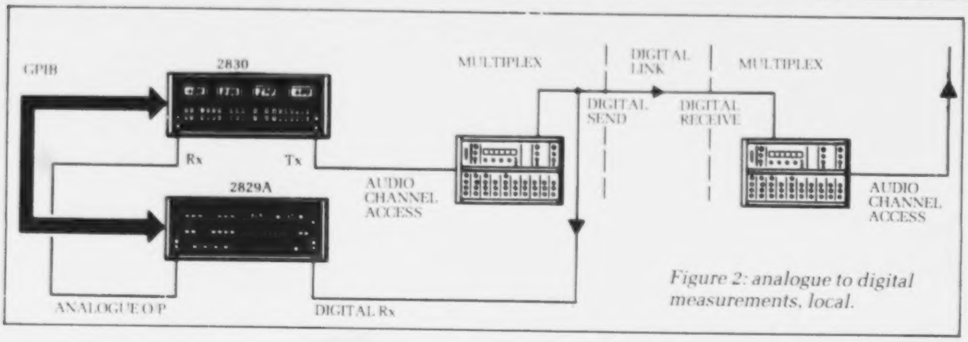


Figure 2: analogue to digital measurements, local.

nance purposes. For example, an idle channel could be identified by monitoring the 4-bit signalling word of the channel at a 2048 kb/s monitor point with a digital analyser.

Having established connection to an idle channel both analogue to analogue end-to-end and local analogue to digital measurements can be performed without affecting other traffic. This means that end-to-end performance can be verified and, if a problem is identified, it can be isolated to the near or far end multiplex.

Analogue to analogue measurements, end-to-end

End-to-end measurements are the final arbiter of a good circuit where all parts of the transmission medium are included in the tests, both terminal and line.

In Figure 1 the receive-end multiplex tester acts as the controller via the modem link for the remote transmit-end tester. Establishing a connection between the two instruments by means of the integral modem forces the transmit-end instrument into SLAVE mode, i.e. it comes under the control of the modem. Thus a complete series of tests, either manually or automatically sequenced, can be initiated and controlled from the measuring end of the link. After completion of the tests, a similar set of measurements can be taken in the reverse direction, with the two instruments reversing roles. (Where a separate line is not available for the modem link, it is possible to use the return path of the channel under test.)

Analogue to digital measurements, local

A suspect channel can be further tested to isolate the faulty end by performing analogue to digital measurements on the transmit half. In this instance the multiplex tester is used in conjunction with a digital analyser as shown in Figure 2.

If the test is satisfactory, then by implication the fault lies with the distant receive channel. The return path can be verified at the distant end by a similar method.

The digital analyser will also indicate the quality of the transmit multiplex with a display of error rate alarms.

Primary multiplex – digital access

Data services at higher and higher bit rates are now being offered to customers in many countries worldwide. These services are supported in the network using primary multiplexes with data interface cards giving a basic maximum access rate of 64 kb/s. Lower rates can be supported using various sub-multiplexing strategies such as the International Consultative Committee on Telegraph and Telephone (CCITT) Recommendation X.50. Correct functioning of data channels can be verified in a manner similar to that employed for analogue channels but using different test equipment.

64 kb/s performance measurements

High-speed data services at 64 kb/s are currently being offered to subscribers by many PTTs worldwide. The links will normally be

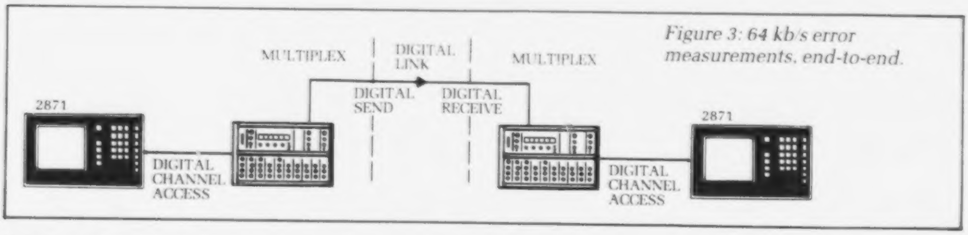


Figure 3: 64 kb/s error measurements, end-to-end.

connected through the network via primary or higher order multiplexes and line sections as well as being extended out to subscribers from the local exchange on a local loop.

Performance of data circuits is far more critical than for speech circuits, and measurement techniques which take into account the different requirements have been developed and incorporated into CCITT Recommendation G.821. This specifies the error performance of a 64 kb/s link, not just in terms of error ratio and error-free time but also availability.

New generation test equipment is incorporating this capability. Other useful features which assist in fault localisation are the ability to log all errors and alarm events with a time and date stamp, and to present this information in an easy-to-read histogram format.

The configuration shown in Figure 3 shows two testers communicating at 64 kb/s via a primary data multiplex. Access could be at the exchange or within the subscriber's premises. GO and RETURN paths could be tested simultaneously and the test could be completed with one tester using remote loopback. In this latter case, however, faults would not be isolated between the two directions of transmission.

The tests described above will normally be performed when commissioning new circuits, but can also be done as a maintenance function on suspect or faulty channels without having to take the rest of the multiplex channels out of service.

The configuration in Figure 4 assists in the fault localisation process. Where a particular transmission path is suspect, the transmit multiplex part can be verified by this means. A test signal is transmitted through the suspect channel and extracted from the 2048 kb/s stream by means of a digital line monitor with time slot access capability. The 64 kb/s output is then fed back into the tester to be checked for errors.

2048 kb/s digital line sections

The vast majority of 2048 kb/s traffic is carried over multi-pair telephone cable with regenerators spaced at 1.8km intervals, corresponding to the previous positions of loading coils for analogue transmission. The number of regenerators in use in networks is therefore extremely large and represents a major maintenance overhead to any administration.

Trio testing

Trio testing is a regenerator fault location technique which has been in use for many years and will continue for many years to come.

Each regenerator location has a bandpass filter set for a particular frequency in the audio band. When a line section is declared faulty, a regenerator fault locator is connected to the section as shown in Figure 5 and the following procedure adopted. The pattern generator output is set to transmit triplets, or trios of pulses, the polarity of the trio being modulated at audio frequencies corresponding to the bandpass filter of each regenerator in turn, F_1, F_2 . . . F_n. Good regenerators will pass an appropriate audio frequency back to the selective level measuring set (SLMS) section of the tester, whereas a faulty regenerator will cause a reduced or non-existent level to be detected, thereby locating the faulty regenerator.

Other techniques

Some new generation line systems incorporate integral error checking capability and alarm systems, thereby reducing the need for other test equipment. Some administrations also use automatic protection switching so that faults will not cause loss of traffic to subscribers. Also gaining favour are centralised maintenance centres which automatically collect and collate fault reports from the network, thereby enabling swift and efficient corrective action to be taken.

2048 kb/s performance assessment

Where 2048 kb/s systems are carrying data or being supplied to customers as part of a service, performance levels need to be strictly controlled. Deterioration of performance below a level relating to a particular tariff will not necessarily cause an alarm.

Thus it may be necessary in some circumstances to perform in-service monitoring of 2048 kb/s lines where deteriorating performance is suspected or there has been customer complaint. Disputes on performance can also arise where services are carried by more than one carrier, or where there is division of responsibility within an administration.

In these cases in-service monitoring of particular 2048 kb/s lines can give a solution. Both line code and frame word errors can be monitored giving an indication of local and overall performance, and some degree of fault localisation. In addition, an assessment is made of 64 kb/s channel performance in terms of error-free time. These measurements, together with a time logged printout of alarm and error events, can provide verification of network performance.

64 kb/s performance assessment

On particular 64 kb/s channels, no measurements can be made in traffic where performance problems are suspected unless the traffic is structured. However, where structured traffic is used, for example with the submultiplexing strategy X.50, then the framing information can be monitored to assess error performance.

Figure 6 shows a typical instrument configuration for 64 kb/s monitoring, the digital line monitor extracting the required channel from a 2048 kb/s monitor point and passing it to the data communication analyser for measurement. Measurements can be unattended if required, with provision for hard copy of results if necessary.

Future trends

The cost per mile of optical fibre has dropped dramatically since its first introduction into networks some years ago. The trend is to higher and higher bit rates as volumes of data increase dramatically. 565 megabits/second (mb/s) systems are beginning to be installed and there is already talk of 1.2 gigabits/second (gb/s) in the near future. However, reducing costs also affect the applicability of optical fibre at lower bit rates. Although 2048 mb/s optical fibre is currently not economically justifiable in its own right, the ability to upgrade to higher rates relatively easily is a very persuasive argument. It also reduces maintenance costs, with line sections containing few, if any, regenerators.

Maintenance equipment thus begins to take on a new look – with optical power meters and optical time domain reflectometers becoming a possibility for the future. □

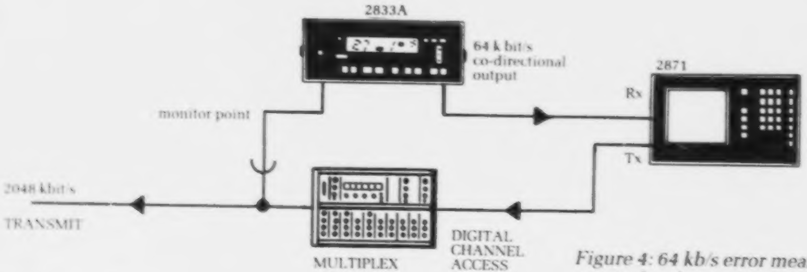

2833A
64 k bit/s co-directional output
2871
Rx
Tx
monitor point
2048 kbit/s
TRANSMIT
MULTIPLEX
DIGITAL CHANNEL ACCESS

Figure 4: 64 kb/s error measurements, local access.

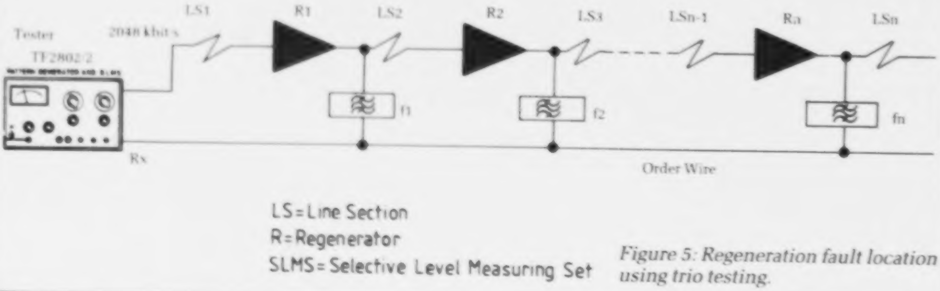

Tester
TF2802/2
2048 kbit/s
LS1
R1
LS2
R2
LS3
LSn-1
Rn
LSn
f1
f2
fn
Rx
Order Wire
LS=Line Section
R=Regenerator
SLMS=Selective Level Measuring Set

Figure 5: Regeneration fault location using trio testing.

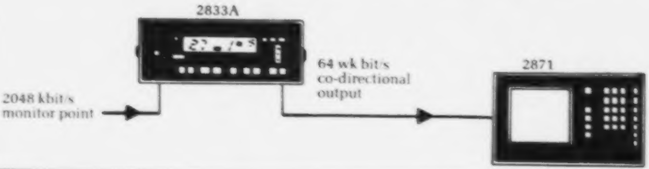

2833A
2048 kbit/s monitor point
64 wk bit/s co-directional output
2871

Figure 6: 64 kb/s data channel access on 2048 kb/s lines.

A remote testing system can diagnose the fault and thus avoid time-wasting and often unnecessary journeys for engineers.

REMOTE TESTING: A RELIABLE WAY OF FINDING THE FAULTS

by Graham Powell

Maintenance of telecommunications networks is a major priority if a service is to run smoothly and cost-effectively. Graham Powell, Managing Director of Vanderhoff Communications, describes the processes behind a major remote line testing system.

THE provision of a remote line testing capability should form part of every modern telecommunications service's fault repair facilities. The principle, in general terms, is that staff at a central point can access and test lines at other remote exchanges and determine the nature of the problem without having to send engineers on long, often unnecessary, visits to unmanned exchanges or customers' premises. This remote testing capability is particularly valuable when telecommunications facilities are being provided across terrain where physical movement of personnel is more difficult than in urban areas.

Remote testing is also especially useful where, as in most developing countries, older technology strowger exchanges are in use alongside newer crossbar and electronic designs. Knowing something of the nature of the fault before dispatching field engineering personnel will contribute to a speedy rectification in hybrid networks.

A brief look at the actual test processes involved should further highlight the virtues of remote testing for telecommunications networks, wherever they may be situated.

Fault centre staff have individual visual display unit (VDU) terminals to access all remote test units located at the exchanges which they cover. By entering the customer's directory number, the exchange's remote test units are connected to the customer's line. A choice of test methods is then available.

In automatic mode, activating the remote test unit causes it to measure alternating and direct voltage, resistance and capacitance, returning the results for display on the VDU.

In manual mode, fault centre staff can select any of the automatic tests and also measure current (alternating and direct), noise level and loop-disconnect or multi-frequency signalling and check for the presence of a dial tone. There are other more detailed tests which can be made by engineering people. If desired, the system will continuously run selected tests as an aid to detecting intermittent or transient fault conditions.

In addition to responding to faults reported by users, the system can also be programmed to make routine checks of selected groups of customer lines to spot deterioration before it affects customer service. Once programmed, the system's master station initiates these group tests automatically. Relevant data – access information, test tables, test window parameters and customers' number lists – are loaded automatically into the system's memory at a pre-assigned time. Monitoring is done by the master station periodically polling the remote test units to obtain lists of customers' numbers whose test results fell outside acceptable limits.

Field personnel can also access the system via the public switched telephone network using MF signalling. They can then make a series of tests to locate faults, to confirm fault clearance or to test correct functioning of a new installation. Results of these tests are indicated to field staff by synthesised speech – no response from repair service control personnel is required. This facility provides compatible measurements for both control and field staff and could dispense with the need for the latter to use separate fault location equipment.

System enhancements

System configuration is achieved by adding to the master station's database. As part of this process, exchange interface information relevant to individual remote test units is electrically downloaded to remote test units' EPROMS (Erasable Programmable Read Only Memory).

Additional features are continually being developed. For example, to enhance user appeal it is being made possible to access remote test units by their exchange's name as well as trunk code.

The system can also be customised by using the enhancement facility to assign local plain language statements to fault diagnostic messages.

In addition to diagnostic software which provides users with plain language messages about fault conditions and terminating equipment configurations, local descriptive messages may be organised to aid fault handling by the control organisation.

For example, other diagnostic software permits the system to identify from measurement of resistance and capacitance whether the terminating equipment on an exchange line is a branch system or individual telephone instrument. Such equipment exhibits distinctive patterns of resistance and capacitance which, after initial measurement, are stored in master station line signature tables along with locally assigned equipment statements. Actual test measurements are compared with values held in the table and matching results cause the plain language statement to be displayed to the system user.

As the variety of line termination arrangements increases, this feature, along with the other diagnostic messages provided by the system, will enhance fault handling within control organisations.

Speedier tests

Work is also going on to improve the telephone exchange test access information. The facilities provided by these test access circuits vary widely, depending on the technology of the exchange switching unit. For example, electronic and crossbar exchanges provide information during the setting up of test calls while strowger exchanges permit single digit step-on between consecutive exchange numbers. By exploiting these various conditions it is possible to speed up testing operations and, in particular, routine testing of blocks of customers' lines.

To speed up the testing rate, overlap testing features can be added to the remote test unit which provide for access to two test trains in one exchange. Effectively, the remote test unit is testing one customer's line while another is being accessed. This will increase automatic routine testing to some 240 numbers per hour per remote test unit.

District testing

In Britain, British Telecom is working on a link between the remote testing systems and the mainframe computers which are beginning to support the new customer service system now under development. Open systems interconnection interfaces for both master station and remote terminals are also being developed in order to increase the system's accessibility and thus its speed of operation.

These developments mean that a country's telephone authority could have staff dealing with the general public at information centres, phone shops, etc., who also have access, through the computer links, to the remote test facility. Test results and diagnostic statements could be presented to those staff together with relevant customer information held on the mainframe, and the staff would be better equipped to answer customers' queries regarding line problems, suitability of new equipment, etc. In short, the customer would benefit from a service more adaptable and flexible than before, capable of meeting the changing needs of telephone users. □

LOOK TO TIW — WORLD
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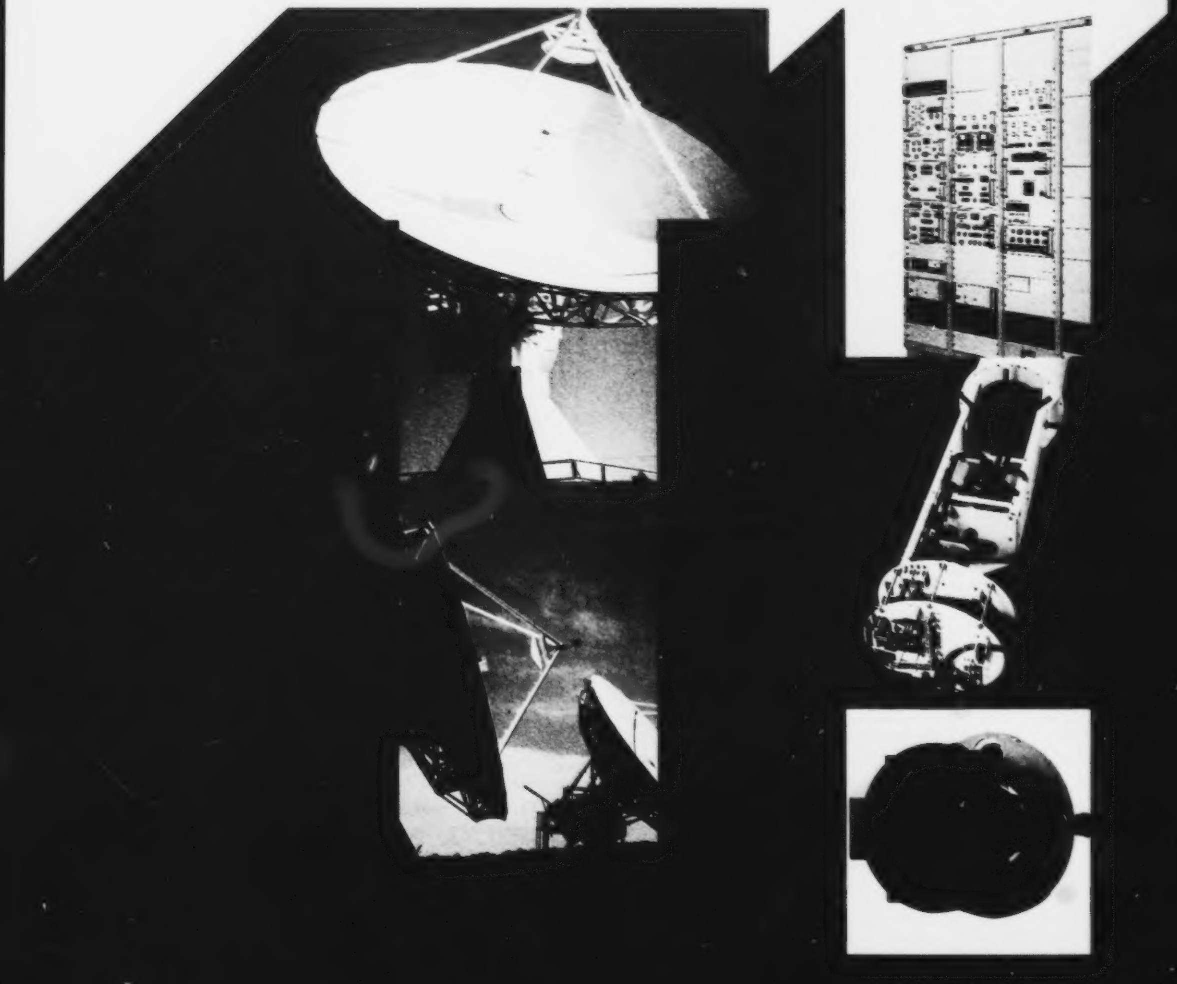

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Satellite Communication Antennas

In excess of 45 TIW Systems Satellite Communications Antennas have been installed in 18 countries. These high quality antennas have been providing service for INTELSAT, INMARSAT, ECS, COMSAT, and US DOMSAT applications and special markets such as Radio Astronomy since TIW's founding in 1976. TIW is a full turnkey supplier of antenna systems including system design, manufacture, complete installation and test capabilities.

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Satellite Communication Earth Stations

TIW has installed complete Earth Stations for major communications applications for U.S. customers including COMSAT and RCA. In the case of a full earth station, TIW supplies the transmission, receiving, monitoring and control equipment, as well as the antenna structure, antenna feed and antenna controls. TIW offers full installation and test capabilities as well as civil works as required.

Antenna Systems for Telemetry, Tracking and Control (TT&C)

TIW is a major supplier of antenna systems for TT&C applications for the following programs:

INTELSAT V
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AUSSAT
BRASILSAT
RCA DOMSAT

The TIW TT&C antennas perform normal station-keeping functions for geostationary orbiting satellites as well as the more complicated injection and transfer orbit operations.

TDMA Terminals

Multipoint Communications has developed its MULTIPOINT TDMA Terminal. The MULTIPOINT TDMA is a low rate, subtransponder TDMA terminal which enables a user to put multiple carriers in a transponder. This enables many user networks to operate within a single transponder offering the advantage of lower space segment cost to network users. MULTIPOINT TDMA Terminals have been delivered to AT&T Bell Laboratories and IBM.

Network Control

Each user of a TDMA network requires some level of Network Control capability. Multipoint Communications offers Network Control Software for use in the networking of its Multipoint

TDMA Terminals. Based on the experience gathered in developing this facility, MULTIPOINT COMMUNICATIONS offers customized Network Control software capabilities to telecommunication users.

Automated Station Maintenance and Control

TIW Systems with proven experience in antenna systems and earth station maintenance and control, and Multipoint Communications with proven maintenance and control of TDMA networks, offers custom software and hardware for the automatic monitoring and control of widely dispersed networks.

Earth Station Upgrading/ Retrofit Service

TIW Systems is a fully integrated supplier of antenna systems equipments. TIW is also a full turnkey supplier with the capability to provide any element of earth station equipments including TIW designed feeds and servo and antenna control equipments.

As antenna system components age and as technology advances, it becomes necessary to upgrade or retrofit various portions of the antenna. This upgrade might include the installation of a full frequency reuse antenna feed to be capable of utilizing newer satellite services. Upgrading antenna control and servo becomes necessary after 10 to 20 years of continual service. Reshaping and resurfacing the reflector panels may become necessary. All of these components and elements of an upgrading program can be provided by TIW.

Earth Station Integration Services

As full turnkey suppliers, TIW and Multipoint Communications offer integration of a complete Earth Station beginning with the antenna and RF equipments; the transmission and receiving equipments; the TDMA, Network Control, Maintenance and Control; and all baseband equipments. TIW will act as a fully integrated supplier including civil works as required.

Antenna Feeds

TIW Systems designs and builds satellite communication and tracking feeds, in S, C, L, and Ku-bands. These feeds are linear, circular, combined linear and circular, and full frequency reuse. Tracking feeds including monopulse and pseudo monopulse are available.

Antenna Control and Servo Equipments

TIW builds antenna control and servo equipment utilizing a microprocessor based control system. The system utilizes a precision digital position loop for high resolution. Systems for step-track, autotrack, and monopulse tracking are available.

Amplifiers

TIW offers a complete product line of general purpose and special amplifiers for the laboratory, CATV, instrumentation and security markets. Amplifiers include fixed gain, variable gain, video, preamp, buffer, limiting, mixer and high power.

TIW
SYSTEMS, INC.

AUSTRIA-TELECOMMUNICATION GmbH

Austria-Telecommunication GmbH was established jointly by Austria's two leading private share companies in the telecommunications sector, Kapsch AG and Schrack Elektronik AG. The company is engaged in the development, marketing, planning and maintenance of digital telecommunications systems. AT is founded on a firm financial basis, and can take best advantage of the great economic and technical strength provided by the two founding companies.

Research and development are handled by a joint project management system. A staff of highly-qualified specialists and technicians has been brought together from the parent companies to turn the grand aims of AT into reality.

Although AT carries out many activities 'in-house', a variety of other tasks such as material procurement, production, and in particular, quality control are delegated to Kapsch AG and Schrack Elektronik AG. The two companies have more than ten production centers throughout the world catering for the worldwide market.

The many decades of experience gained by the parent companies covers not only the field of public telephone systems but many other specialized sectors as well, such as

- digital transmission;
- rural communications;
- civil works;
- training and education;
- installation and maintenance;
- consultancy and customer support.

All these have been incorporated in AT, so promoting the company's work in developing, planning, supplying and maintaining complete telecommunications systems.

AT is a licensee of the Canadian company Northern Telecom and has invested several hundreds of man-years in the development and adaptation of the Austrian Digital System, ADS, a system which meets the standards of the CCITT, the CEPT, and the Post Office authorities.

The ADS system was worked out in close co-operation with Bell Northern Research in Ottawa, Canada, and the Northern Telecom development center. The two companies are among the world leaders in the development and production of digital telecommunications systems.

This system, the ADS, provides a complete range of digital switching equipment, and includes the following:

- ADS-100 Local exchange with up to 100,000 subscriber lines;
- ADS-200 Tandem/transit exchange with up to 60,000 trunks;
- ADS-100/200 Combined exchange.

The outstanding features of the ADS system family are:

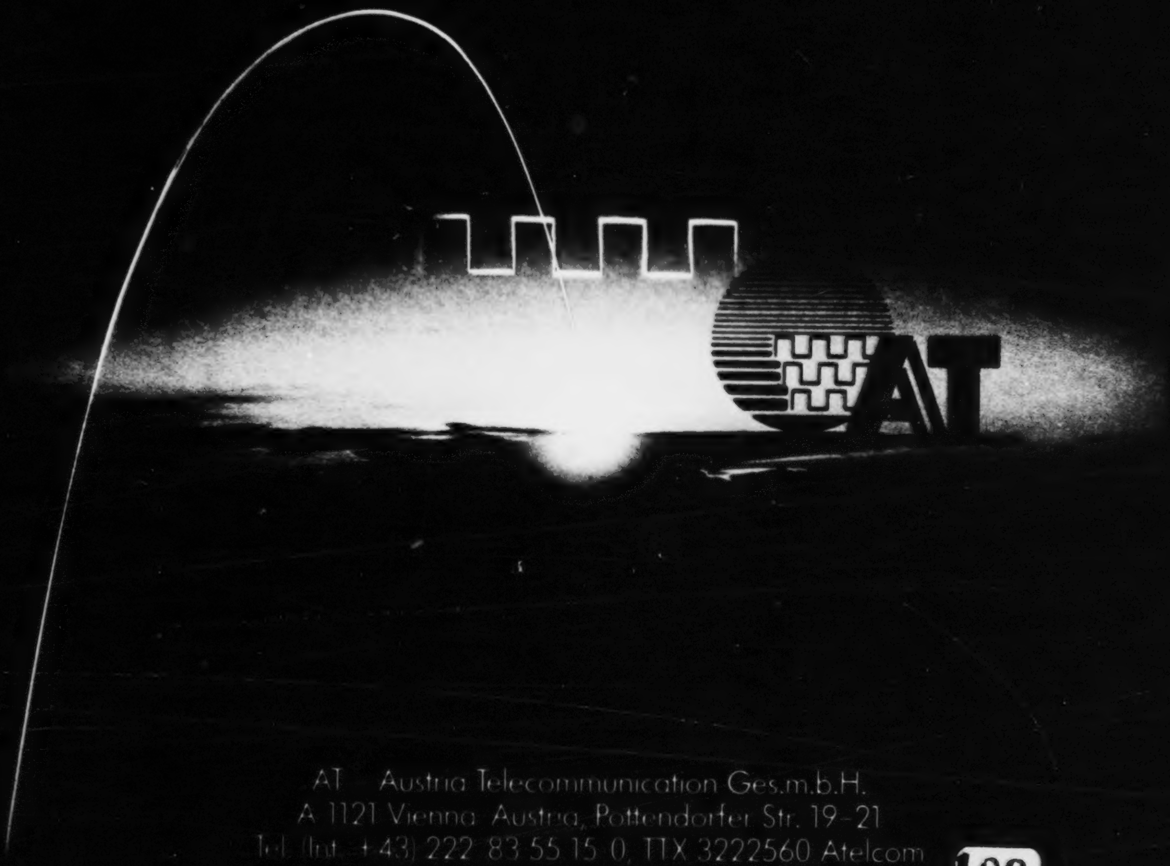
- Optimized distributed systems architecture with unique system modules throughout the whole systems family;
- Analog to digital conversion on a per line basis;
- Easy application of any level of a telephone network, thanks to high flexibility of hardware and software;
- High reliability achieved by redundancy and systems architecture;
- Cost effectiveness thanks to the modular architecture, enabling tailor-made design for exchanges in terms of capacity and features;
- Modular growth from small to large units by simply adding the required functional modules;
- Extraordinarily comfortable man-machine interface, providing a 'zoom-in' capability far exceeding CCITT recommendations and making operation, maintenance and administration of the system significantly easier.

ATs relationship with its partner companies puts it in the unique position of being able to utilize the long experience of companies in both the production and operation sectors, companies which hold more than 30 per cent of the world market share.

AT, then, is able to offer its clients a range of services which guarantee performance at the very highest level as well as maximum profitability. In addition to systems planning, installation, and testing, AT can provide personnel training, technical assistance, network planning, and further development of the system during operation.

The Way into the Future of Telecommunications

Austrian Digital Switching System



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A-1121 Vienna, Austria, Pottendorfer Str. 19-21
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agora’ TELEAUDIOCONFERENCING SYSTEM integrable with video-graphic aids.

Applicazioni Elettrotelefoniche A.E.T. SpA has taken an integrated approach to the teleconferencing problem bearing in mind the necessity to keep transmission in the standard low-frequency telephone field, and so it has experimented and set up AGORA' system of teleaudioconferencing with videographic aids that exploits only a 4-wire telephone channel (300 - 3400 Hz) for transmission. The above aiding means are:

Facsimile transmits hard copy of documents in advance or during the conference;

Slow scan TV may work in place of a slide projector and transmits still pictures of objects or documents (where there is no facsimile);

Telewriting replaces the traditional blackboard and permits the exchange of graphic marks (writing or drawing) that the user creates at the moment, with the addition of colouring to improve the displaying.

NETWORK

The possible network choices are: **leased lines network,** consisting of private and dedicated direct links; **4-wire switched network,** in Italy a special quality public network is available called voice-data-network (RFD); two 2-wire lines of a general switched telephone network.

Leased network and RFD may be in point-to-point or in multipoint structure in order to offer a real conference also with many sites connected together at the same time.

EQUIPMENT

The ATC equipment studied and manufactured by AET permits the setting up of a teleaudioconference and connects up to eight microphones to collect the sounds in the room, and loudspeakers to diffuse the incoming signals from the remote rooms through the telephone line; the rooms are thus in communication with each other with a phonic quality able to guarantee intelligibility and naturalness of speech.

The other basic function of the ATC equipment is the control of the available network type (or types), and the switching of the lines to the various services. The following lines may be connected to ATC: a line of a 4-wire leased line; or two lines of general switched telephone network.

Should the ATC equipment also perform the function of star-centre for a multipoint leased network of interconnected rooms, it is necessary to add a matrix option to the equipment and to connect the interested lines.

In the ATC equipment an optional group can be inserted to obtain a 200 telegraph channel within the telephone band and so offer another means of communicating, contemporaneously with speech conveniently used to transmit telewriting.

VIDEOGRAPHIC AIDS

To increase the possibility of information exchange during the meeting the following means may be added to normal conversation: telewriting, as stated, contemporaneously with speech and slow-scan TV, or facsimile, as an alternative to speech. When it is necessary to transmit an image, framed by a TV camera, by the slow-scan TV equipment, the speech connection would be suspended for 20 to 30 seconds and then resumed.

By means of a Video-mixer apparatus the images of the telewriting system (described further-on) and of the slow-scan TV (either the one transmitted or that received) or, in place of the latter, the image of a local TV camera are shown on the same monitor after having been inlaid and synchronized.

The described superimposing function permits the use of telewriting as a graphic quotation of the image shown on the monitor screen and proves especially useful to indicate, to underline, to complete, to show changes, and so on, on the subject being discussed.

TELEWRITING

The telewriting system used by AET consists of a graphic processor and a graphic tablet with an associated pen; the image is displayed on the monitor screen of the person writing, and at the same time the graphic processor transmits the information through the 200 baud telegraph channel towards the remote equipment, which reproduces the same marks on the other screens. Thus, remote rooms promptly receive, in real time, the same image, so that vocal commentary can be made on the writing.

Furthermore, the image may be of two colours (red or green) that are easily seen against the black and white background image.

The telewriting system is also interactive because any one of the participants may correct, add, enlarge, rub out or point to the graphic marks even if these have been traced in different rooms (or on different equipment).

Telewriting has its own memory and can store up to 15 pages drawn on the graphic tablet (unless it is switched off).

Recording on permanent memory support is available.

THE ROOM

The room, where all the teleaudioconferencing equipment should be installed, has to be evaluated according to the functions and services required by the subscriber, who may decide on a simple office room, an already prepared meeting room, or a large conference room.

The system studied and proposed by AET allows the use of rooms without any special acoustic treatment (even if it is convenient and improving to cover some of the walls of the room with drapes or sound absorbing material) because of the particular treatment made on the microphone signals performed by the ATC equipment.

agora'

A teleaudioconferencing system arises from the requirement of meeting many people in several localities and to put each other in touch to discuss and deal with common problems. Once, in the ancient Greece, agorà was the place destined prevalently for vocal communication among people. Applicazioni Elettrotelefoniche A.E.T. SpA has designed and manufactures **AGORA' Teleaudioconferencing System** integrable **with video-graphic aids** that through simple telephone links allows the communication by voice and images. With this System, telephone conversation is extended to many persons and is enriched by the possibility of discussing documents or pictures of objects and of exchanging writings, graphics and drawings however keeping operating costs.

agora
RFD
RTC
LD
aet

aet

Applicazioni Elettrotelefoniche A.E.T. SpA
Via G. Re 47 - 10146 Torino (Italy)
Tel. +39 11 71761 - Telex: 221560 AET TO I

Networks Under Control Down Under.

An Australian computer and communications company has developed a system which makes private networks both accountable and manageable At its simplest, the system provides network wide call accounting and directory assistance The system, called CATCOM, can be expanded to deliver complete management information on all aspects of the netwrok, including the hither to unmeasureable usage and cost of private tie lines It is designed for both voice and data communications A major facility is the alarm system which identifies faults on trunk circuits, tie lines, and switching equipment The very efficiency of today's PBXs can be a mixed blessing They do a magnificent job of maintaining communications by stepping around faulty tie line circuits and finding an available route through the public network At the same time, unfortunately, they hide the loss of the tie line until the problem manifests itself in the form of call congestion high phone bills and user complaints

CATCOM will immediately warn the network manager of a fault, allowing the problems to be rectified before they get out of hand

CATCOM interfaces directly with PBX models from a wide range of vendors, providing complete management even in mixed vendor networks

Cost splitting

A sub-system for cost allocations tracks each extension individually then produces exactly the level of information required, be it by extension, territory or nationwide department For example, the sales department might have offices in all major cities and a heavy communications overhead due to stock and distribution queries CATCOM will accurately allocate public charges to users and recover the correct proportion of private line usage

The network manager controls the output according to the company's needs, using familiar internal structure and terminology

Review and prophesy

Of course, the same information can be used to review the performance of the network and the people who use it

Customized reports can be readily designed with CATCOM, contributing directly to effective planning

Should our sales department report show a "hot spot" of communications activity, this could indicate a growing market needing more manpower and upgraded equipment It could equally mean that the sales manager is moonlighting as an off-course bookmaker! The CATCOM network report highlights areas for management attention

Real time directory

Recruitments and retirements alone cause continual change in even the most stable organization Fast growth can totally overpower a paper directory system, leading to internal confusion and poor service for incoming callers

Although technically a byproduct of CATCOM, the onscreen directory is a powerful tool in its own right It can revolutionize an operator's ability to serve the public and dramatically reduce the unseen cost of internal staff information

Operators can consult their terminal with a minimum of keystrokes to identify the correct extension by name, department, title or function An inbuilt message facility details absent or transferred staff and changes of responsibility Conversely, the operator can use the facility to hold messages for staff, obviating the need to physically distribute or collect notes

Operator updates are automatically available to all CATCOM controlled points of the network

Divisions and departments can print out as much or as little of the directory as they need

Distributed facilities

CATSCO architecture allows the appropriate level of facilities to distribute across the organization, from a simple call data collection unit at smal branches to the full power of CATSCO Reporting and Directory for the larger divisions

Hardware

The CATCOM system is based on a Torch Central Network Processor equipped with colour bit-mapped graphics screens and a Mouse/icon man-machine interface to insulate the non-technical user from the complexities of the Unix operating system Both 8 and 32 bit microprocesssors are employed

The distributed processing architecture provides a high degree of resilience to hardware failure and allows time sensitive functions such as Directory screen response to be realized within low cost multiple microprocessor architecture In addition, the use of industry standard operating systems and computer busses (VME and SCSI) allows the system to support a wide range of third party devices for special applications

Flexible Software

Unix System V, 4 GL databases and X.25, X.28 communications software can be tailored in modules that suit the users unique requirements

As examples,additional subscriptions are under developement for a data network operations and graphical subsystem and for public voice network remote maintenance

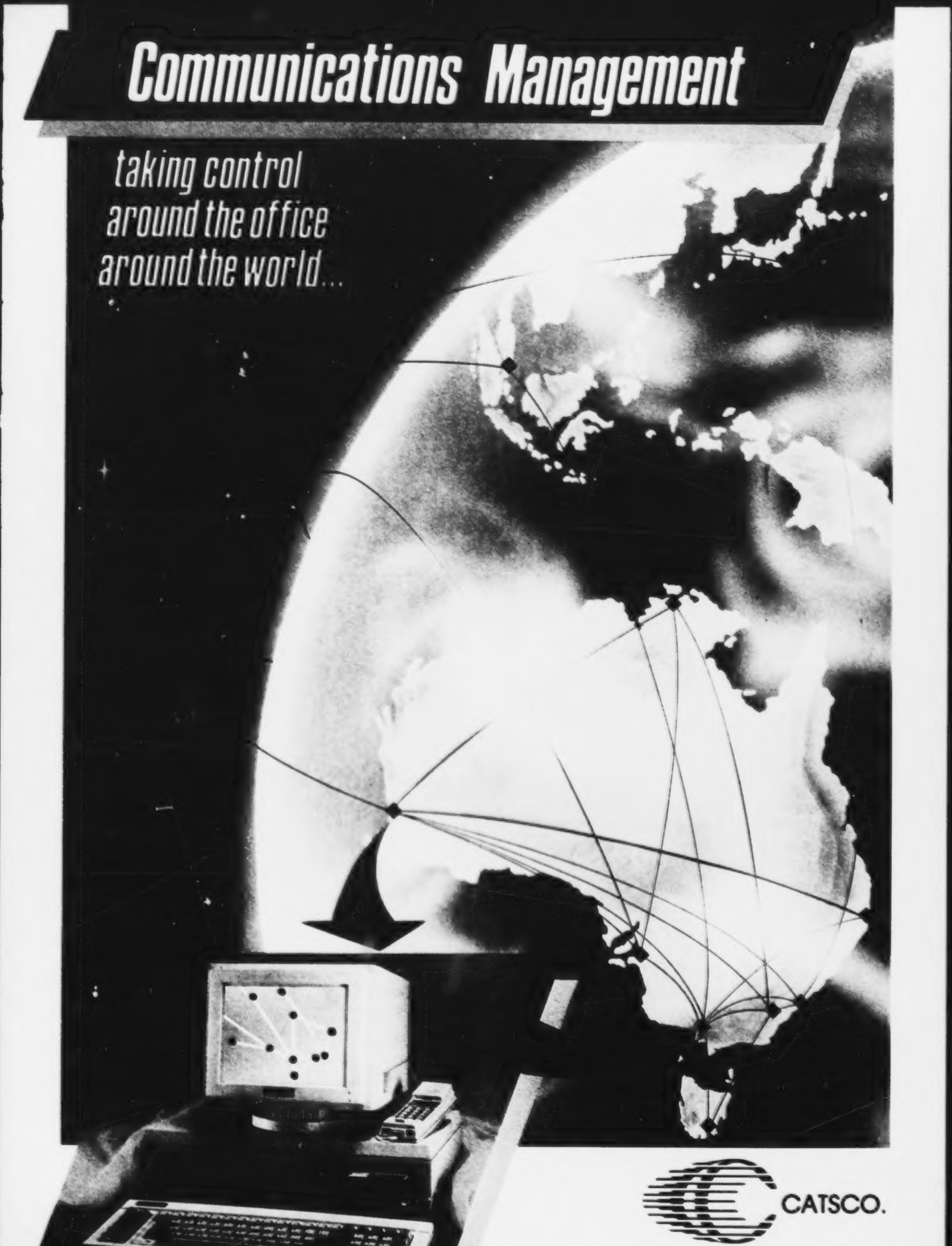
The suppliers.

CATCOM is a product of the Cats Company Pty Ltd who already supply Call Accounting and Directory Systems to Australian Telecom

Nearly half of the company's human resources are invested in software development It is a privately owned Australian company specializing in the provision of computer-assisted data collection and processing systems for effective management of major business operational assets The emphasis is on telecommunications products but their skills are also being applied in other areas, such as automated Road Tanker distribution for the Shell Oil Company

CATSCO.

Enquiries can
be directed to
Cats Company Pty Ltd.
P.O. Box 240 Prahran, 3181, Australia
Telex AA34105. Telephone 61-3-511565.



Communications Management

taking control
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around the world...

CATSCO.

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Telex: AA34105 Catsco. Telephone: 61-3-511565.
Facsimile: 61-3-5292134.
Correspondence to: P.O. Box 240, Prahran, Victoria 3181, Australia.

TELECOMMUNICATIONS:

THE ANSWER OR THE PROBLEM?

Traditionally, telecommunications has been synonymous with telephone services, but in the last few years new technologies have entered the "communications" arena. Standard telephone cable has been joined by fiber optic and microwave transmission. And, complex security systems are becoming a part of many "telecommunications" systems.

Today you can easily send voice, data and video signals anywhere. *That's the answer.* Wire, fiber, and microwave technologies, though quite different from each other, are unfortunately still thought of as "telecommunications." *That's the problem.*

There needs to be a clearer distinction between the technologies and the services that can be provided through their application. Failure to recognize this means designing and installing such a system, even a relatively simple one, could take you longer and cost you more than you are willing or prepared to invest.

Understanding each of these unique technologies, what makes them work, where they are most appropriately applied, and then intelligently integrating them into a sensible and expandable communications system generally requires the assistance and support of a company with serious experience in developing total communications networks.

One company which has consistently demonstrated this capability is Centro Corporation of Salt Lake City, Utah. For years, Centro has designed, installed and maintained total communications systems including sophisticated telephone, radio, paging, microwave/fiber optic communications, card access and closed circuit television. Systems requiring the transmission, reception and storage of voice, data and video signals.

The odds that current communications technology will reach a standstill or that new technologies won't emerge in the near future are more than slim. Staying abreast of the rapid changes in this very dynamic industry and, at the same time, meeting your expanding communications requirements, is what Centro does best.

Centro Corporation, 369 Billy Mitchell Road, Salt Lake City, Utah 84116 1-800-654-4870

For communications systems you can trust, call the company you can rely on, Centro.

Improperly designed communications systems, can make your business life difficult to impossible. Your clients can become irritated, orders can be lost, and sales can decline. But, it doesn't have to be that way, not any more.

At Centro, we know that from the simplicity of telephones to the complexity of microwave or fiber optic transmission, the goal always is the same. Total Communications.

If your phone is working, give Centro a call. Have one of our communications specialists review your problems. They understand the importance of high quality communications systems and uninterrupted operation. And, they can show you some very interesting alternatives.

We've built our reputation and our capabilities around delivering precisely that, alternatives. Centro can help you with systems design and engineering, as well as equipment selection. We can assist you in site selection and installation of a microwave tower, do the ground restoration and landscaping, and can even handle FCC licensing and FAA permits. And, we're willing to work with you on a turnkey basis or by the project.

Whether you're interested in upgrading your current telephone or two way radio system, installing a local area network using the latest fiber optic or microwave technology, adding the sophisticated control of a card access or closed circuit video security system, call the company you can rely on. Call Centro.

Centro specializes in total communications.

Centro is a subsidiary of Skaggs
Telecommunications Service, an
American Stores Company

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Centro

Centro Corporation
369 Billy Mitchell Road
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TELECOMMUNICATIONS NETWORK SURVEILLANCE AND CONTROL

US SPRINT CONTROL CENTER

As one of the largest independent telecommunications companies in the USA, US Sprint has over 1,000 sites of microwave, satellite and fibre optics equipment forming a complex telecommunications network throughout North America. To monitor, control and maintain this extensive network requires state-of-the-art technology capable of rapidly detecting marginal and complete outage communications conditions. It must also notify operators at the appropriate control centre to ensure that remedial action is taken immediately and effectively.

In 1984, US Sprint, then known as GTE Sprint, initiated a program of modernization and expansion of their network surveillance and control system. This was part of an overall program to improve the reliability and cost effectiveness of their services in an increasingly competitive market.

Datap Systems was selected from 20 international companies and awarded a series of contracts to supply the system hardware and to provide system engineering, integration and software services for the project.

The system consists of three Regional Control Centres (RCC's), each using two computers in a standby configuration, running Datap Systems IRIS 7 supervisory control software packages. IRIS 7 provides data acquisition, remote control, and event logging capabilities in an interactive environment using colour graphic terminals. Each RCC typically processes in excess of 10,000 events per day. Site data is obtained via District Control Computers (DCC's) which are located at network maintenance centers and intelligent Remote Terminal Units at equipment sites.

Project Highlights

- Real time computer analysis of the systems performance;
- Rapid identification of network trends, outages, and failures;
- Flexible user controlled data base;
- Independence of telecommunications equipment manufacturers
- Priority alarm selection
- Advanced selection criteria for alarm history reporting
- Trouble ticket generation and administration
- Regional data concentration
- Colour graphic CRT workstations with on-line editing facilities
- Powerful database and graphic display editor to allow on-line additions and changes by US Sprint
- Integration of RTU's from various manufacturers.

ADVANCED NETWORK MANAGEMENT

By Datap

- **Maximize Your Network Efficiency** Achieve fully centralized remote monitor and control-capability on your network. Use Advanced Network Management systems from DATAP Systems to monitor and control all types of network facilities: electronic switches, high capacity microwave/cablewave/fibre optic facilities, satellite earth stations.
- **Minimize Network Downtime** Control center personnel monitor real-time displays of the network, achieving fast problem identification. Current equipment status, performance data, alarms conditions and full remote control capability are all displayed on easy-to-use video monitors, allowing online correction as problems develop. Downtime is minimized by establishing corrective action immediately.
- **Keep Pace with Network Growth** When new facilities are added to your network, your Advanced Network Management system modifies easily. Colour-graphic displays, reports, and new data are added without any interruptions to the system's operation.
- DATAP Systems is a leader in Network Management systems. Please contact us for further information about Datap solutions for Advanced Network Management.

DATAP SYSTEMS

[illegible]

Kapsch

KAPSCH AG is one of the largest Austrian companies in the electronic industry, which makes it an important representative of Austrian industry and economy. The company is a leading manufacturer of data and telecommunications equipment, has more than 2,300 employees and operates six manufacturing plants and six branch offices. Kapsch AG, with last reported annual turnover of 2 billion Austrian Schillings and investments representing more than 140 million Schillings, has its head office in Vienna.

With the latest developments in the field of telecommunications new methods of transferring voice, image and data are being introduced. The contribution made by Kapsch includes full-digital public telephone and data transfer systems, the planning and setting up of special networks for customers in both, government and private organizations as well as PBX installations, utilizing state-of-the-art technology — 'Business Communications Systems' in all sizes.

By improving methods of communications and intensifying interpersonal contacts, Kapsch is meeting both economic and social needs.

With the introduction of microelectronics, the essential prerequisites for creating new performance features in PBX system have been established. The new business communications systems from Kapsch contain programmable functions in modular structures, which enable their capacities to grow step-by-step to meet the increased demands. Thanks to the combined use of digital technology and memory programmed control systems — taking into account the international specifications (CCITT) — these telephone systems can be enlarged to become full communication systems for voice, data and image transfer, allowing the utilization of the latest communication media, such as interactive videotex, teletext, telefax etc. all via one single central exchange point.

Kapsch is also the front runner in further development of existing communication networks. Systems for improving line utilization, such as multiplexers and PCM transmission links allow for the potential growth of the existing telecommunications networks. Multiplex technology thus brings about a decisive improvement in communications.

Austrian Telecommunication GmbH — a subsidiary of Kapsch AG — is developing and manufacturing the ADS digital telecommunications system for public networks. Also in Austria the public telephone network is being converted to digital technology. The beginning of 1986 was marked by the commissioning of the first digital telephone exchange using the ADS system by the Austrian Post Office.

Kapsch has been supplying major customers with telecommunications equipment for a long time. The company has specialized in planning and providing complete telecommunications systems, and for many years Kapsch products have been proving their quality and value in the telecommunications market. The products include items such as radio relay systems, carrier frequency devices for digital and analog transmissions, remote control systems, transmitter systems, telecommunication monitoring, traffic control systems and radio systems, and radar installations for airspace supervision and navigation. The program has been further supplemented by voice and data radio systems for use in national defence, by urban and rural police forces, fire brigades and ambulances, at sports events, on construction sites, and on industrial and commercial premises.

In the field of international communications by satellites, Kapsch has played an important part in the construction of satellite ground stations.

Kapsch was founded in 1892, and the history of the company is an accurate reflection of the technical development of the twentieth century: telegraphy, the early days of telephony, the development of subscriber trunk dialling traffic, and the upswing of radio and television. From a small mechanical workshop with 18 employees, the company developed steadily, from a general partnership in 1904 and a share company in 1916, until the success in the manufacturing and marketing of products in the field of telecommunications and transmission equipment and in the development of capacitors made Kapsch a significant element in the economy of Austria. The worldwide exchange of experience, co-operation on international projects, and the export of know-how have made Kapsch an internationally recognized industrial authority.

International relations have been established by licences, patents, know-how contracts, and exports to 41 countries on five continents.☐

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Tel: (0222) 85000*
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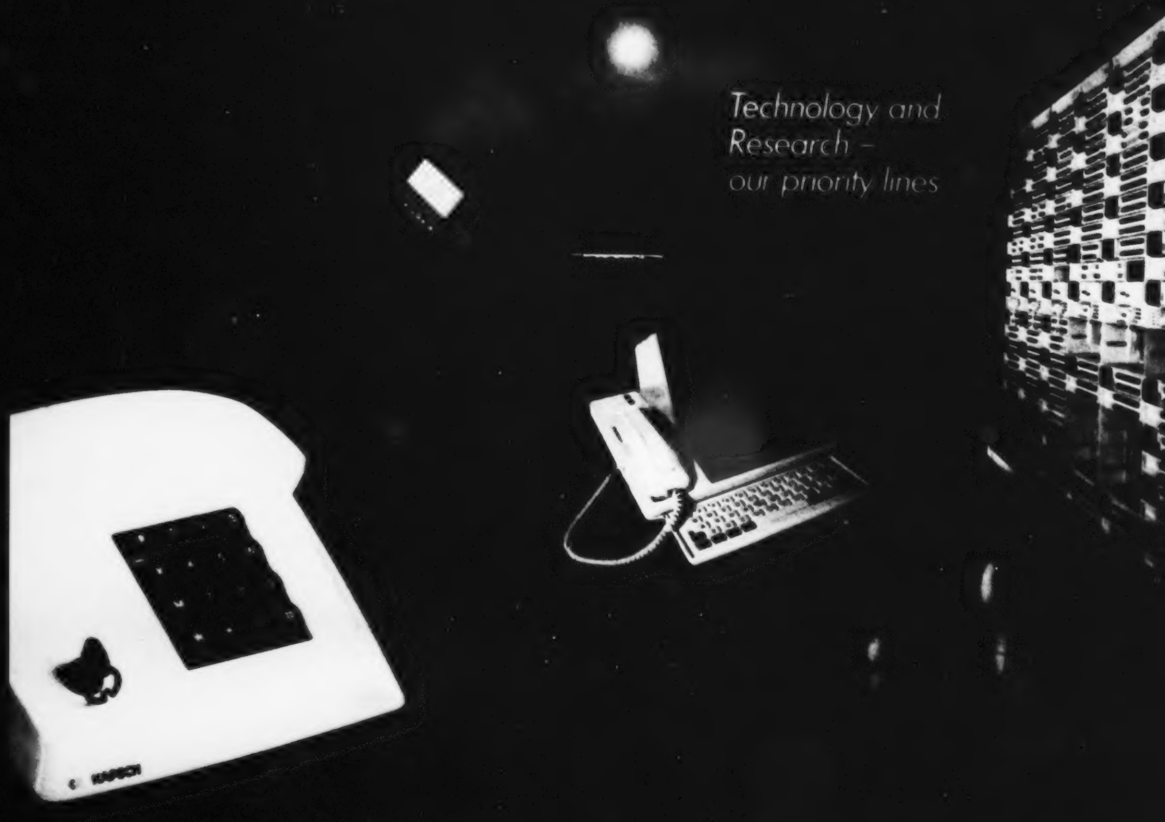
KAPSCH

Telecommunications and Data-Technology
the links that link mankind


Technology and
Research –
our priority lines
KAPSCH

Siemens AG Österreich

Siemens in Austria – that means more than 15,000 Siemens people working in research and development, consultancy, planning, manufacture, assembly and after-sales service. What Siemens has to offer includes the entire range of communication and data technology, energy and automation engineering, medical engineering, electronic components, program and system development, right through to electrical domestic appliances.

About 31 % of our sales are achieved in exports. To take just a few examples, we are helping with the modernization of the Egyptian telephone network, with the construction of new railway lines in Algeria and Egypt, with the construction of a new broadcasting centre in Libya; and all over the world, we take a leading part in power station projects, in setting up sound and broadcasting studio engineering systems, and in establishing simultaneous interpretation installations. And to take a few examples more, Siemens Tunnel Technology, "made in Austria", is a vital part of the equipment for Hong Kong's two motorway tunnels.

The Republic of Austria holds 43.6% of the equity capital of Siemens AG Österreich.

Communications Engineering

In the communications engineering sector we can offer digital exchange systems for voice, text, and data, transmission technology equipment, testing engineering, and terminal units of all kinds. We are taking a vital part in setting up the new digital electronic telephone system for the Austrian Post Office, and we are establishing the Austrian Post Office's interactive videotex system, using software developed in Austria. We are happy to export our know-how – anywhere in the world.

Program and Systems Development

Our Program and Systems Development, known as PSE, employs than 1,900 highly-qualified staff members, and is one of the largest software concerns in Europe.

Computer software is developed here for use all over the world, and parts of the CHILL programming language (CCITT High Level Language) originate from Siemens PSE in Austria.

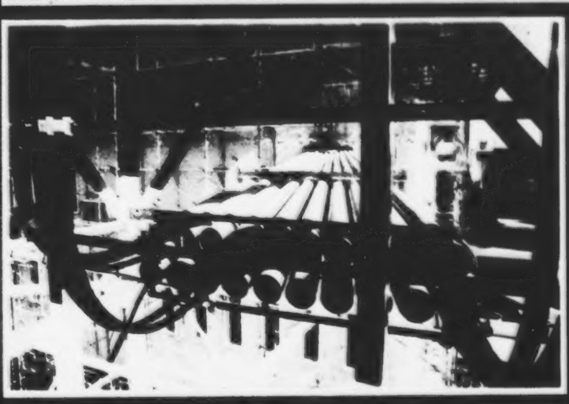
Sound and Broadcasting Studio Engeneering

Television technology to bring events from all over the world directly into your home, technically superb radio broadcasts, theater and concert performances, international congresses...

And the sound and broadcasting engineering behind all these technological achievements was to a large extent developed and manufactured in Austria. Sound switching systems and mixing desks for radio and television performances, outside broadcast and report vehicles, complete studio equipment systems, simultaneous interpreting and conference installations, amplifier systems, ultrasonic testing equipment...

We are happy to export our technology – anywhere in the world.

Chips form the foundation



calzavara s.p.a. is engaged in the telecommunication field for over 20 years. Nowadays our company is structured with four different departments: ENGINEERING, PRODUCTION, INSTALLATION and TECHNICAL SERVICES. The experience, know how and flexibility of our organization guarantees to our Clients a wide range of services regarding the maintenance and realization of **turn key radio networks.**

ENGINEERING, SUPPLY AND INSTALLATION OF :

- Passive repeaters for microwave links.
- HF - VHF - UHF and microwave Antennas and feeders.
- HF - VHF - UHF and microwave equipments.
- FM and television broadcast systems.
- Rural radio telephone systems.
- Mobile telephone systems.
- Self supporting and guyed transmission, telecommunication and radar towers.
- Electric power lines.
- Antennas and radar radomes.
- Emergency guyed structures for radio networks.
- Obstruction light systems.
- Shelters.
- Accessories for telecommunication.

DESIGN AND REALIZATION OF :

- Traditional and special foundation works for towers, supporting structures and passive repeaters.
- Infrastructures for telecommunication exchanges.

TECHNICAL SERVICES regarding :

- Site investigations and survey.
- Radio propagation tests.
- Supervision and consulence services.

MAINTENANCE OF RADIO NETWORKS.

calzavara s.p.a.

telecommunication systems

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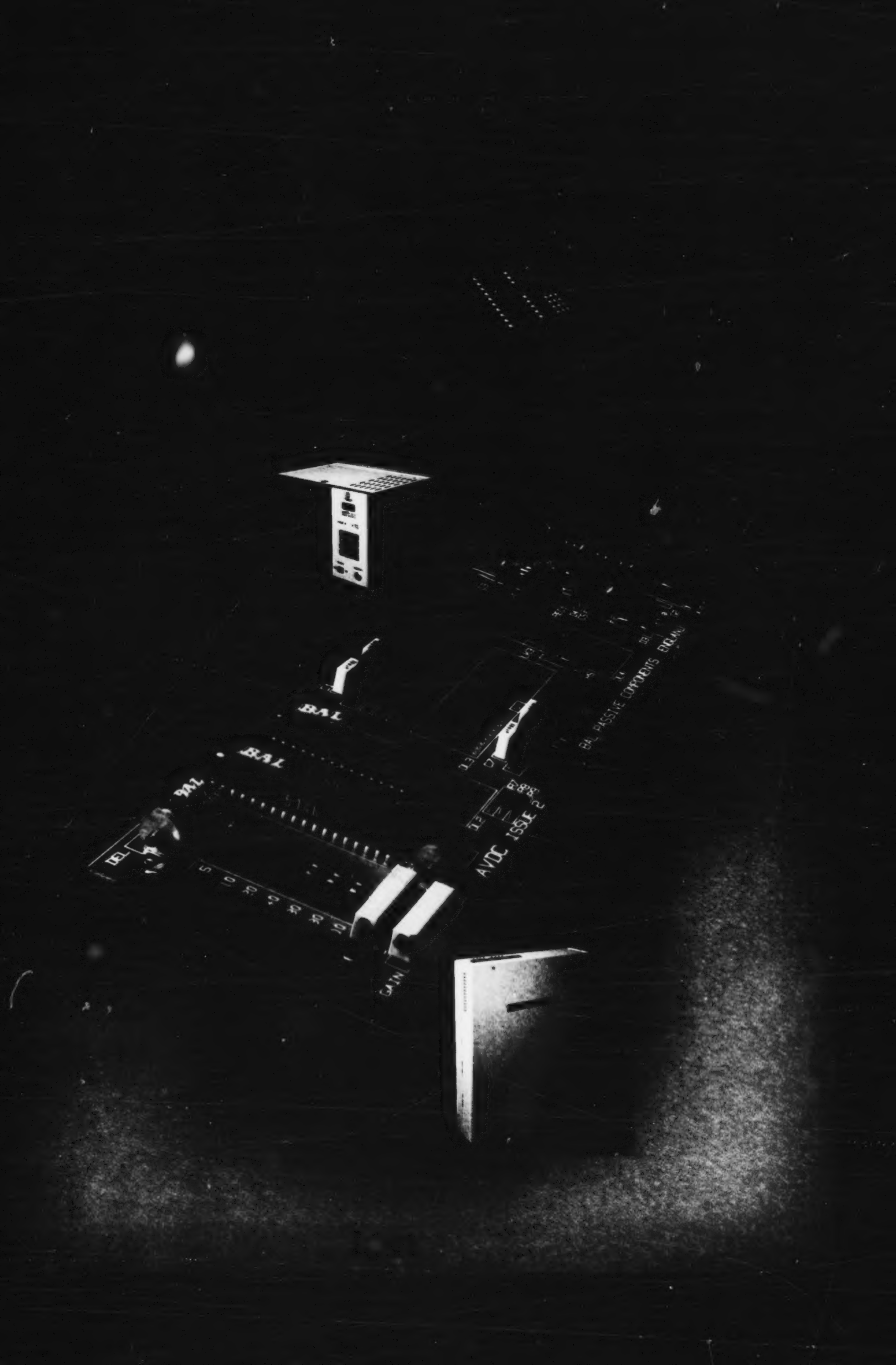
BAL
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BAL
DEL
AVDC ISSUE 2
BAL PASSIVE COMPONENTS ENGLAND
GAIN

It's surprising what a clever 10-year-old can come up with.

It's a mere 10 years since we started in the telecommunications and datacommunications business.

But already we've earned worldwide recognition as one of the industry's leading trailblazers.

We developed the world's first 20 and 30MHz delay lines and filters for high definition TV. Developed one of BT's first automated line test systems. And designed and produced Mercury's Smartbox interface with the BT network.

In fact, these and dozens of other bright ideas are typical of what we do best. Turning complex communications concepts into economic marketable products.

Today, we're looking well ahead to the end of the next decade — working on scores of projects that range from satellite technology to international digital signalling.

Our portfolio of design and manufacturing skills is available to anyone interested in a successful trading future.

Contact us now and we'll help you get there faster.

Vanderhoff—

the 'new' name in world telecommunications

Vanderhoff is one of Britain's most promising young companies in the telecommunications industry. Just over a decade old, it has grown in the last two years or so from a sub-contracting manufacturing unit to a force in the telecommunications market.

Vanderhoff designs and manufactures all manner of systems from special purpose telephones, through small PABXs to the edge-of-technology remote line test systems used by British Telecom, and the Mercury Smart Box.

This wide ranging expertise and manufacturing capability can now be used for the benefit of telecommunications authorities, marketing companies and end users in all countries of the world; for 1987 is Vanderhoff's export growth year.

Vanderhoff plc consists of three carefully inter-related companies:

Vanderhoff Communications Limited

Vanderhoff Business Systems Limited

BAL Components Limited.

How and why Vanderhoff plc evolved in this form is an interesting success story.

Vanderhoff began its growth a decade ago as a small, privately owned British telecommunications engineering company. Vanderhoff manufactured sub-systems and assemblies for the entrenched PABX makers, for British Telecom (then the Post Office), for the Public Utilities and several similar organisations.

Today that capability has developed into Vanderhoff Communications Limited. The company is a major design service and manufacturer for public telecommunications authorities in the UK and already in many developing countries.

Vanderhoff's work in these areas showed the company the opportunities available from electronic components manufacture. BAL Components Limited was formed to begin diversification of the group's interests into computer and broadcasting systems components.

During the last two to three years, a logical development for Vanderhoff from designing sub-systems for other manufacturer's products has been to design and manufacture products for its own company. Vanderhoff Business Systems Limited now markets end user telephony products under its own name via its network of UK telecom distributors and dealers. Many of these products are included in the 1987 Vanderhoff export drive.

Vanderhoff Communications Limited.

The company has been a leading name for years within the telecommunications industry for complex electronics, communications and security systems design and manufacture, and is involved in some of Britains's most notable advances in public telecommunications services. Customers include — in the UK and other countries — the public telephone authorities, major PABX manufacturers, public utilities and Government departments.

In the UK, both British Telecom and Mercury Communications use Vanderhoff Communications' designed and manufactured systems. Remote line telephone testing systems, public network interfaces, database access systems, are among the important projects in which Vanderhoff Communications currently are involved.

Direct speech communications innovation shows through with Vanderhoff designed systems being a UK market leader with newly developed 'data intercom' facilities.

A remote telephone system for use in areas of hazardous voltages was developed in conjunction with Britain's Central Electricity Generating Board and is now manufactured by Vanderhoff.

In less visible spheres, the company has major projects in defence communications, much of it a classified nature, and development contracts for other communications systems manufacturers where unusually high levels of expertise are required.

Control and training communications systems are developed and made at Nuneaton for civil and military aviation use. For example a recent contract was awarded by the Royal Navy for a naval battle simulation radio system complete with its own deliberately induced interference, weather conditions and enemy jamming.

Vanderhoff Business Systems Limited.

Vanderhoff Business Systems has deliberately designed and produced an innovative product range for customers who need greater communications capability in an easy to use, and understand, form.

Vanderhoff Business Systems' range includes small PABXs complemented by key systems, answering machines including models for cellular radiophone users and even private household telephone systems. Stat 28 is a PABX with up to 28 extensions and nine exchange lines. It offers all the facilities one expects of today's electronic systems — and more — at well below the price UK users are accustomed to paying. At the other end of the scale, Stat 1 + 5 is a single exchange line, five extension system being installed in people's homes as well as very small office units.

The first cellular radio mobile answering machine is a Vanderhoff designed product, as is one of the first small PABX telephone systems to gain approval after the UK telecommunications market liberalisation.

A clever device of use for companies with unsupervised rural branch offices or with sales or engineering staff who work from home is a call logger — model 400CL. This fits onto one telephone line and prints out the cost, number dialled etc. of every call made. When the person needs to submit a claim for telephone costs incurred the printout shows the overall total and exact details of how it is made up.

Ideas like this are building Vanderhoff Business Systems Limited into a market leader in telecommunications products and providing the opportunities for a planned expansion into other business automation areas.

Marketing in the UK is done via a network of established dealers and in other countries via main distributors based locally and themselves already well recognised in their country's telecommunications industry. But not all countries currently have distributors and Vanderhoff are always eager to hear from companies with a marketing arrangement in mind.

BAL Components Limited.

Market leaders in delay lines and filters for television broadcast equipment manufacturers, BAL Components Limited is moving strongly into the general electronics and computer manufacturing markets, too. Manufacture of components at Nuneaton is supplemented by two-way marketing arrangements with manufacturers in other countries. One arrangement allows BAL Components to be sold in the huge USA market.

Products include video and pulse delay lines and filters, oscillators and pulse transformers, many with innovative technology. BAL Components, for example, was the first company to introduce delay lines with thick film technology amplifiers and the first to produce a 20 megahertz delay line for the emerging high definition television industry.

Advanced high definition television systems now under development need 20MHz and 30MHz delay lines and filters. The first in the world were designed and are manufactured at Nuneaton.

This kind of innovation is continuing with the lively Research and Development team working on new, more precise designs and yet greater miniaturisation. BAL Components has one of the widest ranges of high performance delay lines, filters and associated components of any company in the world.

BAL also lead in the new 1986 specification for YUV filters in colour television. They have the first YUV filters to meet exactly the new spec and perform within the amplitude and group delay ripple templates of CCIR Recommendation 601.

A new cost effective way to test a TV camera's colour reproduction is another BAL innovation. Their Colour Patch Generator, developed with the UK's Independent Television Companies Association Technical Development Laboratories, electronically generates a set of ideal colours which are superimposed onto the camera under test.

Vanderhoff at home.

First reaction from most visitors to the Nuneaton manufacturing unit is one of surprise at the unexpected diversity.

Product output ranges from full telecommunications systems and the CL680 Line Test System to the tiny BAL Components delay lines and filters for the Broadcasting, Recording and Computer industries.

The Nuneaton visitor passes through areas devoted to printed circuit board assembly — some automated, some manual for prototype and bespoke work — to full systems construction and testing. Electrostatic sensitive products are assembled and tested under controlled conditions.

An advanced in-line flow soldering system is a vital part of their manufacture of printed circuit board assemblies. Cable forming, resin encapsulation and silk screening demonstrate Vanderhoff's thorough in-house capabilities.

An example of the importance given to product reliability of all pre and post assembly stages is the advanced PCB computerised automatic test systems.

These test, in seconds, circuit boards which would have previously taken hours and are tested to higher specifications than could be achieved by previous manual testing. Other systems test finished products under simulated field conditions using pre-programmed functional electronic tests.

In fact Vanderhoff's technical design and manufacturing expertise is so high that on occasions, as part of their work in designing systems to meet strict British Standards, the British Standards Institution has asked Vanderhoff to help in the drafting of new standards themselves. For example in areas where specifications do not exist — in-car telephone answering machines is a recent case — Vanderhoff have been invited to draw up a special investigation test schedule which eventually becomes the basis for Standards and test specifications for all systems of that class.

Vanderhoff's Second Decade.

Since the mid-nineteen-seventies, Vanderhoff has expanded its design and manufacturing activities in the telecommunications world. It has also added new products of its own.

It is now a name of substance in telecommunications, not only to people in the telecommunicatons industry, but to telecommunications systems users all over the world.

The company's pedigree equips it admirably through the most rigorous school of all — manufacturing for companies who must satisfy the critical inspections of the world's most exacting telecommunications authority.

So where to in the next decade?

Systems design capabilities are already leading Vanderhoff into mobile communications, satellite technology, optical fibre transmissions and international digital signalling. Product developments are continuing into combined speech/data communications systems both internal and external to the office, into domestic telecommunications systems and specialised communications systems for industrial applications.

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A Wide Range of Communication Equipment from "MASHPRIBORINTORG"

V/O MASHPRIBORINTORG exports over 1000 types of wire and radio communication facilities and more than 300 types of radio measuring instruments to dozens of countries, chiefly CMEA memberstates. Soviet equipment and instruments operate in Austria, Finland, France, the FRG, India, Iran, Iraq, Syria and many other countries.

The Soviet Union is the home of radio and television. Today we produce practically all kinds of equipment, systems and complexes for information reception, transmission and processing: space, radio-relay and cable communication systems, radio broadcasting and telecasting facilities, telephones, telegraph, facsimile and data transmission sets, automated control and data processing systems.

Soviet equipment for space communication systems is used in many countries for the exchange of data via radio-telegraph, telephone and television channels. Other kinds of Soviet-made radio equipment are also used in various countries on a wide scale. Besides meeting the ever growing demand for information, this equipment is of immediate economic benefit.

A steady improvement of after-sales servicing of intruments and equipment is another factor promoting our export trade. A far-flung network of service facilities and consultation points has been established in foreign countries Technical centres have been opened under the USSR Trade Representations in a number of socialist countries to facilitate the after-sales servicing of the items supplied by V/O MASHPRIBORINTORG.

The Ekran and Moskva compact-size Ground-based Stations of satellite television

MASHPRIBORINTORG offers portable and stationary television stations of two types — Ekran and Moskva — for small villages, sparsely populated and inaccessible places.

A TV Station in a Suitcase

The Ekran-K TV station, weighing a mere 12kg, can function both in and out of population centres. It can be deployed in 20-30 minutes and is very economical: its power requirements are up to 20W from 12-V storage batteries or up to 30W from 220-V a.c. mains.

For the Countryside

The Ekran-KR1 station has a service area of 2.5km. It can be turned on and off from a remote control panel up to 1.5km away, the panel being connected to a telephone communication line. The station can operate in a stand-by mode involving low power consumption.

For Cities and Large Settlements

The Ekran-KRP station is designed to operate as part of a TV centre: as it picks up signals from a satellite by means of its own antenna, it relays them through the local TV centre's transmitter and antenna. In this case, the service area measures tens of kilometers.

For Television and Radio Networks

The ground-based stations of the Moskva space television system are set up in places outside the Ekran system's service area.

The Moskva-KRP station, transmitting colour and black-and-white telecasts and radio programmes, is most efficient functionally and economically. It is designed for thousands of hours of operation.

Mobile Communication Facilities

In the USSR, portable and mobile communication facilities are being produced in ever larger quantities and used on an ever wider scale.

The problems involved in the further improvement of these facilities are tackled by both national and international organisations such as the International Telecommunication Union and the CMEA Permanent Commission for the Electronic Industry.

Soviet industry develops and quantity-produces various SW and FM portable and mobile radio stations and radio transmitters with these organisations' recommendations taken into account. These include the Lastochka, Sirena and Kaktus portable radio stations exported to dozens of countries, the Len, Kolos, Mayak-S and Altai-3 multi-channel mobile radio stations, and Angara and Viola complexes, to name but a few of the numerous models. The Molniya-3 and Tsiklon-B radio transmitters, the Transport specialized radio communication systems, the Astra communication systems for coal mines, and other facilities, are widely used.

In the USSR, the world's largest country, these communication facilities put reliable performance in various climatic zones ranging from the Arctic to the sun-scorched deserts. They are used in industry, agriculture, in road, rail and water transport systems. Portable radio stations cannot be dispensed with in prospecting for and extraction of minerals, in the laying and operation of gas and oil pipelines and power transmission lines, in logging, in emergency and servicing operations, research expeditions, etc.

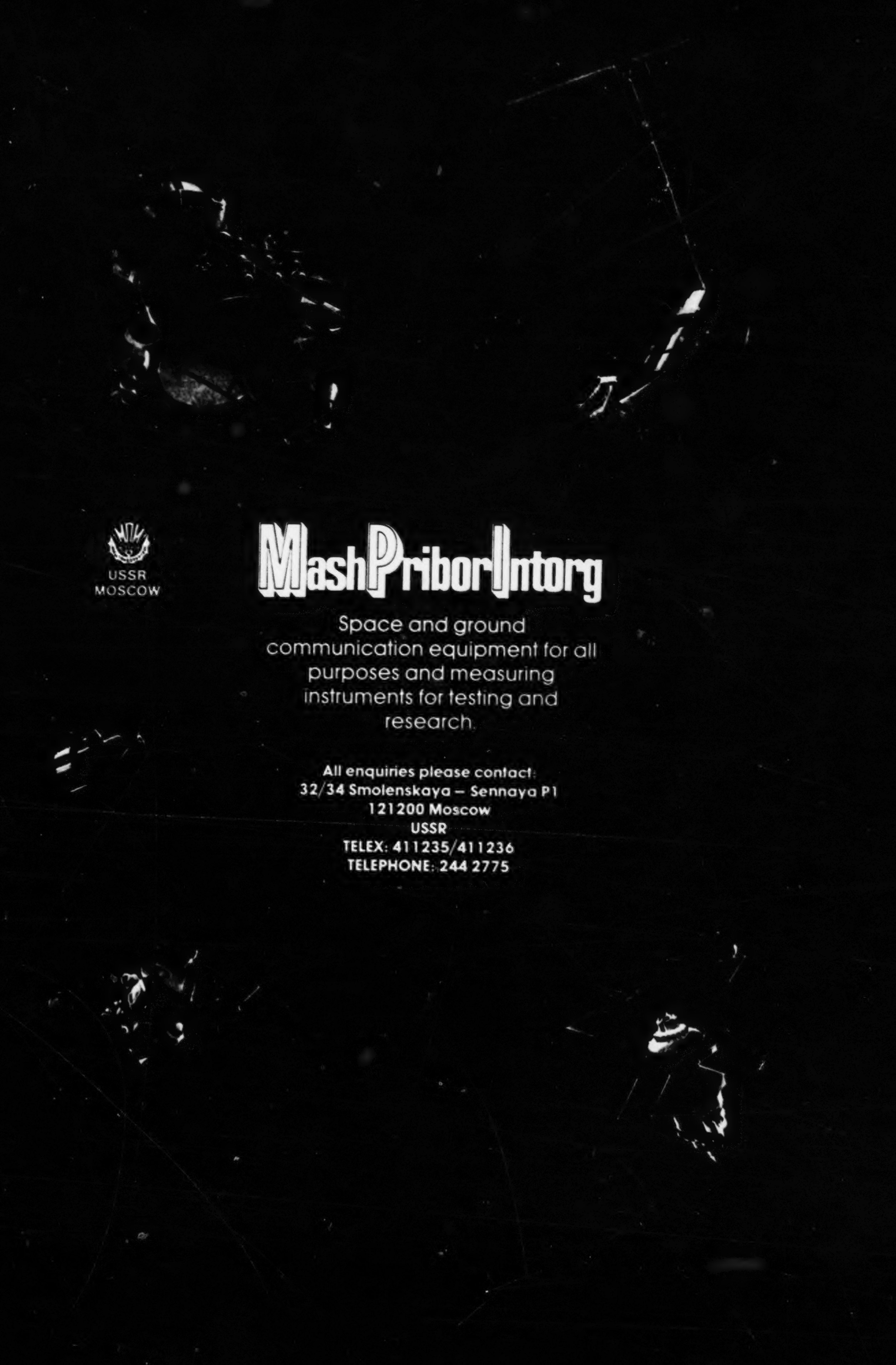
It goes without saying that mobile radio stations must be compact-sized and extremely easy to use, highly economical, reliable and efficient. Soviet radio requipment, exported to dozens of countries, possesses all these qualities.

Radioelectronic Measuring Instruments

The export list of MASHPRIBORINTORG includes more than 300 types of radioelectronic measuring instruments, such as oscilloscopes, frequency meters, signal generators, and voltmeters. These Soviet instruments are used in 30 countries to manufacture and operate electronic equipment and communications facilities, adjust fast-acting computers, and carry out research work in many fields of science and technology. They are used for measuring current, voltage, power, frequency, lumped and distributed parameters, pulsed signal parameters, for displaying and examining frequency response of various radio equipment, signal spectra, and for many other functions.

Soviet exports of radio-electronic measuring instruments are steadily growing to countries such as Algeria, Argentina, India, Iraq, Italy, Syria, Finland, the FRG, Switzerland and have nearly doubled in the last few years.

The main reasons for this marked rise in the demand for Soviet radioelectronic measuring instruments are their excellent specifications, convenient operation, reliability and long service, plus efficient technical servicing Countries importing our instruments have service offices where skilled maintenance personnel guarantees adequate technical servicing. Soviet specialists are on the staff at these offices or arrive there on request to give technical assistance or consultations to local personnel and customers. ☐



USSR
MOSCOW

MashPriborIntorg

Space and ground communication equipment for all purposes and measuring instruments for testing and research.

All enquiries please contact:
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121200 Moscow
USSR
TELEX: 411235/411236
TELEPHONE: 244 2775

STANDARD ELECTRICA: INDUSTRIAL CAPACITY AND INNOVATION

Standard Eléctrica is the leading firm in the telecommunications and electronics sector in Spain. Originally as a member of ITT Corporation, and currently of the Alcatel N.V. European Telecommunications Group, Standard has, for 60 years, supplied its clients and in particular the Spanish Telephone Administration, products and services of the highest technology available at all times.

HUGE INDUSTRIAL CAPACITY AND CONSTANT INNOVATION ARE STANDARD ELECTRICA BASES

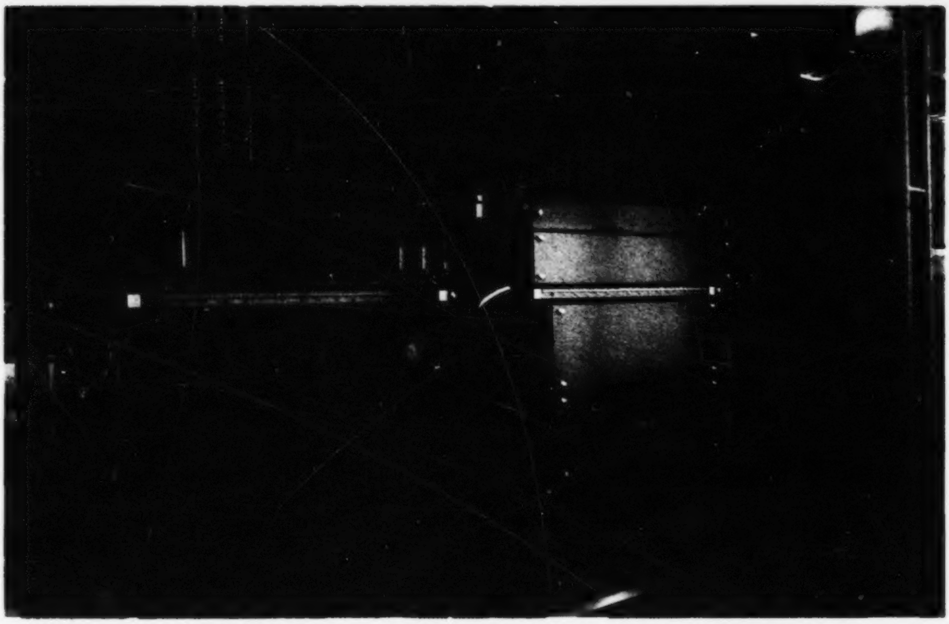
Standard Eléctrica has centered its activity and projection on a broad, continually evolving industrial base and on special dedication to two different aspects of research: on the one hand, development of original products and services; on the other, adapting and introducing foreign technologies in Spain.

Based on a proven line of efficiency and quality, Standard Eléctrica has witnessed the growth of its industrial potential, with plants at Santander (Cables), Madrid (Electromechanical Switching and Flexible Manufacture), Toledo (Digital Switching, Transmission Equipment and PABX), and Málaga (Audiocommunications Equipment).

STANDARD ELECTRICA OFFERS THE MOST COMPREHENSIVE RANGE OF TELECOMMUNICATIONS EQUIPMENT: SWITCHING, TRANSMISSION, MOBILE RADIO, CABLES, TELEPHONES, PABX, COMPUTERS

Evolution and development of telecommunications in Spain have been and are linked to products manufactured by Standard Eléctrica and, additionally, exported to seventy countries worldwide.

Company sales, on the order of 60,000 mil-



STANDARD ELECTRICA FURNISHES SPARE PARTS AND ENLARGEMENTS FOR PENTACONTA EXCHANGES WORLDWIDE lion pesetas annually, reflect the magnitude of Standard Eléctrica, a firm capable of designing, producing and commercializing items of the latest technology.

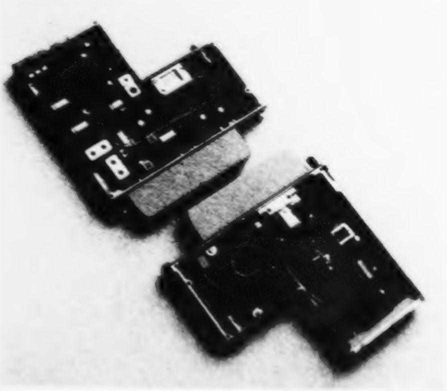
STANDARD ELECTRICA IS THE WORLD'S LEADING PRODUCER OF PENTACONTA ELECTROMECHANICAL SWITCHING EXCHANGES

Standard Eléctrica is the major supplier of telephone switching equipment in Spain, both insofar as electromechanical and digital electronic exchanges.

As regards the former, Standard Eléctrica has broad experience in the manufacture of Pentaconta® type switching exchanges. This type of exchange today forms the basis of telecommunications, not only in the Spanish telephone network, but in a large part of the world where they render reliable and effective service. To date, 7,658,000 lines of this type exchange have been installed in Spain and it is anticipated that another 765,000 will be installed by 1990.

To this experience are added activities in other countries, mainly Venezuela (184,000 lines exported) and Algeria, where a major project was realized - construction and placing in operation of a turnkey plant to produce switching equipment and telephones.

Standard Eléctrica's Villaverde (Madrid) plant produces 300,000 Pentaconta lines annually and also manufactures spare parts for this type exchange which are distributed worldwide.



FIBER OPTICS TRANSMISSION SYSTEMS ARE IN SERVICE IN THE SPANISH TELEPHONE NETWORK

In fact, this plant situates Standard Eléctrica as the world's foremost manufacturer of this type exchange, and offers all users of this system the best post-sales service as well as the possibility of continuing to enlarge existing exchanges.

STANDARD ELECTRICA ACTIVELY PARTICIPATES IN THE DEVELOPMENT OF SYSTEM 12®

In the mid-1970s, ITT determinedly embarked on a strategic R&D programme to develop a universal switching system for the future, based on fully distributed digital processing techniques. This allows a network to be expanded locally rather than centrally, giving the user the flexibility to add processing power where and when it is needed. The result is System 12, a fully digital switch capable of handling a wide range of voice and data signals simultaneously, ideally suited for ISDN (integrated services digital network) applications. The design covers the entire range of switching equipment, from the smallest remote subscriber unit to the largest local exchange. Not surprisingly, in the last three years orders have soared to more than 14 million equivalent lines in more than 21 countries.

Standard Eléctrica has assumed responsibility for designing the system's rural version, besides the task of adapting it to Spanish network. The Toledo plant is equipped with the necessary technological elements for its output and this modern facility today enjoys the capacity required to fill domestic demand and exports as well. Introduction of the system in Spain currently experiences remarkable growth, 150,000 lines having been installed already in more than 20 exchanges; the Spanish telephone administration is committed to install one million lines in the next few years.

STANDARD PRODUCES ANALOG AND DIGITAL SYSTEMS THAT COVER THE FULL RANGE OF TRANSMISSION PRODUCTS

Adhering to a policy of offering the widest array of telecommunications products, Standard Eléctrica continually researches, deve-

SYSTEM 12 HAS INTRODUCED THE LATEST TELECOMMUNICATIONS TECHNOLOGY TO THE SPANISH TELEPHONE NETWORK

lops and adapts the latest technological changes in the transmission products field. At the Toledo plant, where System 12 switching exchanges are produced, line and multiplex transmission equipment as well as fiber optics and cable equipment and modems are also manufactured.

ITT-7700 IS A SMALL SIZE, FUNCTIONAL, LICHTWEIGHT AND TECHNOLOGICALLY ADVANCED MOBILE TELEPHONE

New tecnological advances require an effective response.

ITT-7700 mobile telephones are based on the concept of a cellular mobile radio. They comprise an extremely lightweight and easy to use microtelephone with control unit, a main unit with frame for installing in the car, and a portable case that permits total autonomy.

Its high technology, top quality materials used and extremely careful design, make it the smallest, most functional, lightweight and advanced telephone on the market.

At its Toledo facility, Standard Electrica produces the ITT-7700 with its traditional guarantee of quality and service; it will also shortly produce base stations for the cellular mobile radio system.

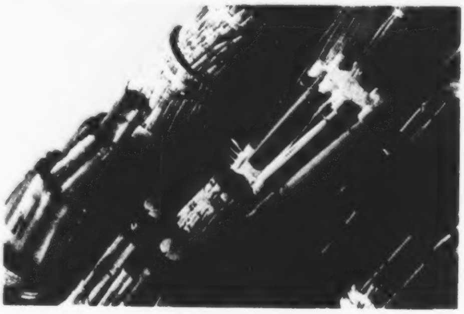
The ITT-7700 is aproved and recommended by the Spanish PTT as subscriber equipment for the Automatic NMT-450 Mobile Automatic Telephony existing in Spain. Similar equipment is in service in five other European countries.

THE ITT 7700 IS MOST SUCCESSFULLY COMMERCIALIZED IN SIX EUROPEAN COUNTRIES

THE PRESTIGE OF CABLES PRODUCED BY STANDARD ELECTRICA IS RECOGNIZED WORLDWIDE

From the simplest paired cables to sophisticated, high capacity coaxial cables, Standard Eléctrica has produced millions of kilometers of cable at its Santander plant, destined for installation in Spain and a number of countries throughout the world, where these products are fully recognized for their quality and reliability.

The Santander plant has at all times had available the latest manufacturing tecnologies appropriate for innovations occurring in this field, as also development and quality control laboratories. Since 1982, the facility maintains a plant devoted to the production of fiber optics cable that manufactures monomode and multimode 18-fiber and 144-fiber cable cores.



CABLES SUCH AS THESE EQUIP TELEPHONE NETWORKS IN SPAIN AND SEVERAL OTHER COUNTRIES WORLDWIDE

Besides fiber optics cable, the plant produces conventional paper and plastic insulated cable, coaxial cable, telephone cords, etc.

STANDARD ELECTRICA IS A LEADING MANUFACTURER OF TELEPHONES IN EUROPE

Three out of every four telephones installed in Spain are produced at the Málaga plant which is equipped with the latest technology. Units are both conventional and of extremely innovative technology. All are characterized for the high standards of quality which have enabled export to a number of countries, among them the United States, Japan and

THE ITT 5700 BCS IS AND APPROPRIATE SOLUTION FOR SMALL OR MEDIUM FIRMS.
AND FOR DEPARTMENTS IN LARGE COMPANIES

Sweden, whose quality requirements are well known.

Among others, Standard Eléctrica produces Góndola, Teide and Satai model subscriber telephones with conventional dial technology and key dialling.

Additionally, it produces new Venturer units whose design features place them among the most technically and aesthetically advanced. The Venturer is of modern modular design; it has a key dialling system and top quality transmission. There are table top or wall models.

TRM: A NEW PHILOSOPHY IN THE PUBLIC TELEPHONE FUNCTION

Standard Eléctrica PAY-station TRM's are outstanding among its telephone output and are most successfully commercialized in Spain and other countries.

This TRM telephone not only introduces sophisticated technology and modern design, but also a new philosophy insofar as the public telephone function.

The TRM is destined for indoor installation in public establishments, official centers, etc., and is operated by the establishment proper, which is able to control the content of coin deposits when it is so desired. The establishment settles with the telephone administration depending on the number of impulses recorded.

This feature is a guarantee against hooliganism targeted on telephone booths and is a major incentive for persons who decide to install the TRM in their establishments, offering clients telephone service without having to be on alert to collect personally for calls made.

THE ITT-5700 BCS PHONE-LAN IS A UNIQUE PRODUCT ON THE MARKET, CAPABLE OF SIMULTAN EOUSLY TRANSMITTING VOICE, DATA AND TEXT

The ITT-5700 BCS (Phone LAN), fully designed by Standard Eléctrica's Research Center experts, is an entirely distributed, integrated and digitalized system which permits simultaneous voice, text and data transmission, combining the advantages and facilities of private exchanges, multi-line and local area networks.

It has a 2 to 64 voice/data station capacity and may be installed as a stand-alone system or integrated into an existing private exchange.

Advantages of the ITT-5700 System

- Improved communications control.
- Flexibility and speed in internal and outside communications.
- Access to and sharing of organization resources.
- Savings in peripheral terminals.
- Connection to personal computers, data terminals, printers, telex terminals, data bases, smart telephones, etc.
- Posibility of incorporating, disconnecting and changing the position of any terminal without the need to interrupt or modify the system's operation.
- Connection to public and private networks.
- Access to digital services.

STANDARD ELECTRICA IS A LEADING MANUFACTURER OF TELEPHONE UNITS IN EUROPE

Honeywell

SPERRY AEROSPACE DIVISION

THE PRODUCTS SYSTEMS

Multiplexers

Data Test Sets

Modems, Racks, Cabinets

Intelligent Network Systems

Speech Plus System

Voice Frequency Carrier Telex Telegraph System

Custom Communication Switching System

Remote Control and Monitoring System

Integrated Communication Control Simulators

The Company

Sperry Aerospace Group has played a leadership role in Canadian High Technology industry for over 50 years. The in-depth expertise acquired in the Avionics, Marine and Telecommunication sectors for both the Defence and Commercial markets have become synonymous of the Sperry name.

This Ottawa, Canada based division of Honeywell provides a comprehensive design, development and production capability for advanced electronics and electro-mechanical equipment.

Today, the group has two facilities in Ottawa. One is devoted entirely to repair and overhaul of Avionics and Marine products and systems. The other plant houses the headquarters, administration, operations, engineering and manufacturing facilities. In addition, a Research and Development Laboratory devoted to microprocessor technology as applicable to the world of telecommunications.

The Market

Company marketing activities have been devoted to the Telecommunications industry, Avionics industry and the Marine industry. The company sales have been directed to the Military, Government, Government Agencies and Training Institutions and Colleges, domestically and internationally.

We pride ourselves on our ability to provide highly reliable cost effective solutions to meet customer requirements. Our recent acquisition by Honeywell will strengthen our capabilities in engineering research and development. The merger will also provide greatly added depth to our worldwide business interest.

International Experience

This Honeywell Division represents over twenty years of experience in the telecommunications market, providing state-of-the-art multiplexing systems, customized communiation switching systems and integrated communication control simulators. We are capable of providing support worldwide through the combined strengths of Honeywell, Sperry Offices, in addition to an established network of agents, distributors and consultants specialized in the telecommunication sector.

For any additional information, please communicate with: Marketing Department.

DOWN-UNDER DATA COMMUNICATIONS EXPERTISE GETS BIG EUROPEAN RECEPTION

AN Australian datacommunications supplier with proven world-leading research and development skills looks certain to become a major force in the fast-growing developing country modem markets throughout the world.

NetComm (Australia) Pty. Ltd, based in Sydney, Australia, has an established track record as a world pioneer in the Apple communications environment, and is an award-winning developer in PC-DOS communications.

The Company is among the largest suppliers of modems in the Australian market. Products range from quality engineered datamodems for the Commodore 64/128 and internally mounted modems for the Apple II family up to powerful 9600 bps CCITT V29/V27 stand alone and rack mounted modems for use in corporate mainframe environments.

NetComm has developed a complete range of modems for PRESTEL Videotex plus Bulletin Board application in a variety of PC hardware environments (including Apple, BBC, Commodore, IBM and compatibles, plus MacIntosh). These products encompass variable speed internal and external units with full Hayes 'AT' command set compatibility for operation at 300, 1200/75, 1200 and 2400bps.

As a platform for its new generation of communications peripherals, NetComm is now shipping its new high security Datalock modems. This state-of-the-art device provides full Hayes compatibility, multi speed, asynchronous and synchronous communication up to 2400bps with sophisticated inbuilt DES encryption, ARQ, PNNP protocols plus constant and variable DTE/DCE speeds.

Designed to provide a high level of commercially applicable security protection for small, medium and large computer sites, Datalock is intended for application in networks and organisations engaged in the regular reporting of highly confidential data.

NetComm's brand label product covers Auto Dial, Auto Answer, Auto Disconnect Hayes compatible modems and all multi speed products support Auto Ranging to ensure connection at constant or varying speeds.

Separate products support CCITT V21/V23, V22, V22bis, V21/22/23, V21/22/23/22bis and where appropriate US (Bell) equivalent standards.

High speed products support CCITT V29/V27.

Software packages are available for Commodore, Apple II, IBM (and compatibles) and MacIntosh, and all software packages where appropriate support full colour Videotex as well as Bulletin Board features. All packages support Auto Dial, File Transfer, Off-Line Data Storage and on line/off line Printing.

Specialised products have been developed, for example the Commodore 68/128 modem. Rack mounted products are also available supporting all of the above mentioned speeds from 300bps through 1200/2400 to 9600bps.

Highly specialised products have been developed to provide X25 PSTN networking, V25bis Auto Calling and X32 PSTN packet switching connection.

Specialised internal modems are also available for Sharp, Toshiba, Apple, COMPAQ, BBC and NEC, IBM portable computers. □

NetComm (Australia) PTY Limited,
Unit B, 25 Paul Street North,
North Ryde, NSW 2113,
Australia.

Telephone (+612) 888 5533,
Minerva: 07.DNC002,
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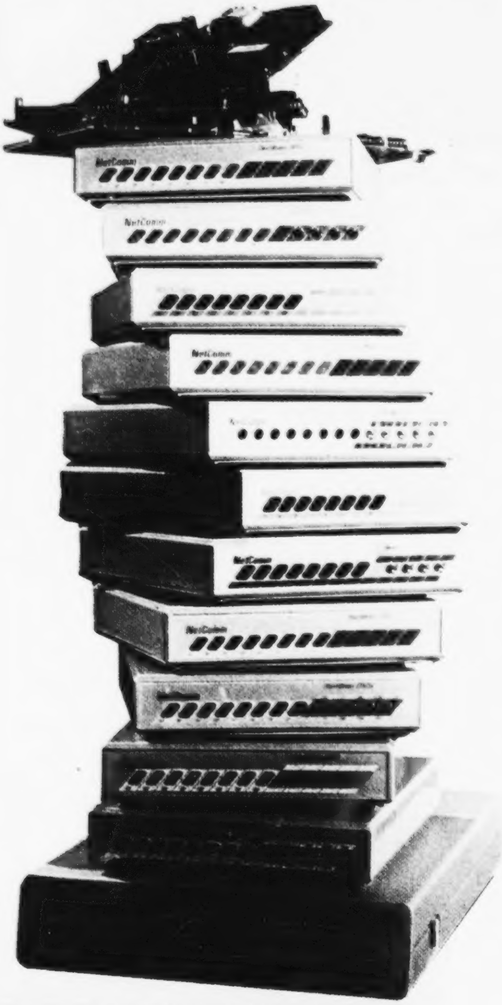
TELEX: AA27488,
TELEFAX: (+612) 887 2839.

In modems, you'll find NetComm stacks up better than the rest.

When it comes to ours or theirs, only NetComm has a modem to suit every communications need.



MODEL	DESCRIPTION	FEATURES	BAUD RATES
CM400	Modem 64/128®	AD, PD, TD, AR, AA, AX, OA, SW, ASY Commodore® Compatible	300 FDX, 1200/75 FDX (CCITT V21, V23)
SM8501	Modem 3+12® NCP	MD, PD, MA, OA, SW, ASY, IBM PC® Compatible	300 FDX, 1200/75 FDX (CCITT V21, V23, Bell 103)
SM8502	Modem 3+12® A	MD, PD, MA, OA, SW, ASY, Apple, II/e/c Compatible	300 FDX, 1200/75 FDX (CCITT V21, V23, Bell 103)
SM860	AutoModem® 3+12	AD, PD, MA, OA, ASY, AT, SW	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V21, V23, Bell 103)
AM100	AutoModem® 21/23	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX (CCITT V21, V23, Bell 103)
AM120	AutoModem® 12/12	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX (CCITT V22, Bell 103, 212A)
AM140	AutoModem® 24/24	AD, PD, TD, AA, AX, OA, AT, ASY	1200 FDX, 2400 FDX, (CCITT V22, V22bis, Bell 103, 212A)
AM160	AutoModem® 123	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX (CCITT V21, V23, V22, Bell 103, 212A)
AM180	AutoModem® 1234	AD, PD, TD, AA, AX, OA, AT, ASY	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX, 2400 FDX (CCITT V21, V23, V22, V22bis, Bell 103, 212A)
SM8911	SmartModem® 21/23SA	AD, PD, TD, AR, AA, OA, AX, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX (CCITT V21, V23, Bell 103)
SM8721	SmartModem® 1200SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	1200 FDX, (CCITT V22, Bell 103, 212A)
SM8821	SmartModem® 2400SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	1200 FDX, 2400 FDX (CCITT V22, V22bis, Bell 103, 212A)
SM8421	SmartModem® 123SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 HDX, 1200 FDX (CCITT V21, V23, V22, Bell 103, 212A)
SM8471	SmartModem® 1234SA	AD, PD, TD, AR, AA, AX, OA, AT, ASY, SY, SW	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX, 2400 FDX (CCITT V21, V23, V22, V22bis, Bell 103, 212A)
DL842	DataLock® 123SA	AD, PD, TD, AR, AA, AX, OA, AT, SW, EP, DE, PW, ASY, SY	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX (CCITT V21, V23, V22, Bell 103, 212A)
DL847	DataLock® 1234SA	AD, PD, TD, AR, AA, AX, OA, AT, SW, EP, DE, PW, ASY, SY	300 FDX, 1200/75 FDX, 75/1200 FDX 1200 HDX, 1200 FDX, 2400 FDX (CCITT V21, V23, V22, V22bis, Bell 103, 212A)
IN600	PC In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (Half Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX CCITT V21, V23, Bell 103
IN610	1200 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	1200 FDX (CCITT V22, Bell 103, 212A)
IN615	2400 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	1200 FDX, 2400 FDX (CCITT V22, V22bis, Bell 103, 212A)
IN620	123 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX (CCITT V21, V23, V22, Bell 103, 212A)
IN625	1234 In/Modem®	AD, PD, TD, AR, AA, AX, OA, AT, SW, ASY, FI (¾ Card Size)	300 FDX, 1200/75 FDX, 75/1200 FDX, 1200 FDX, 2400 FDX (CCITT V21, V23, V22, V22bis, Bell 103, 212A)
TR100	TrailBlazer®	18,000 bps High Speed Modem, AD, PD, TD, AR, AA, AX, OA, AT, EP, ASY	300 FDX, 1200 FDX, 2400 FDX, 18,000 Adaptive Duplex (CCITT V21, V22, V22bis, Bell 103, 212A)
TR200	TrailBlazer PC®	18,000 bps High Speed Modem, AD, PD, TD, AR, AA, AX, OA, AT, EP, ASY, SW, FI	300 FDX, 1200 FDX, 2400 FDX, 18,000 Adaptive Duplex (CCITT V21, V22, V22bis, Bell 103, 212A)
SM2000	SmartModem® 9648PT	AD, PD, TD, AA, AX, SY	2400, 4800, 7200, 9600 HDX 2-Wire and FDX 4-Wire (CCITT V27, V29)
SM2010	SmartModem® 9648DF	AD, PD, TD, AA, AX, SY	2400, 4800, 7200, 9600 HDX 2-Wire and FDX 4-Wire (CCITT V27, V29)
SM2020	SmartModem® 9648HD	AD, PD, TD, AA, AX, SY	2400, 4800, 7200, 9600 HDX 2-Wire Only (CCITT V27, V29)

LEGEND:
AD – Auto Dial
MD – Manual Dial
PD – Pulse Dial
TD – Tone Dial
AR – Auto Ranging
AA – Auto Answer
MA – Manual Answer
FDX – Full Duplex
HDX – Half Duplex
AX – Auto Disconnect
OA – Originate & Answer
AT – "AT"® Command Set
SW – Software Included
EP – Error Protection
DE – Data Encryption
PW – Password/Dial-Back
SY – Synchronous
ASY – Asynchronous
FI – Fully internal for IBM PC and compatibles

NetComm

Total Solutions for Data Communications

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Telex: AA27488 MODEMS Minerva: 07:DNC002 Viatel: 288855330
VICTORIA 94 River Street South Yarra 3141 Tel: (03) 241 0534
QUEENSLAND Suite 6 Level 11 AMP Place 10 Eagle Street Brisbane 4000
Tel: (07) 229 7376

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NE53PC

UNI-LAB will solve your telecommunications problems, modify and up-date your current technology and have you reaching out to the world. UNI-LAB provides professional experienced services for Consulting, Design and Project Management specialising in TELECOMMUNICATIONS SYSTEMS ENGINEERING.

UNI-LAB's expertise has allowed it to concentrate on projects which require a specialised or multi-disciplinary approach, demanding the techniques of Systems Engineering.

UNI-LAB are troubleshooters. Their Engineering team has extensive practical field experience in all areas of the Communications Industry. They can offer service as a Turnkey Systems House specialising in telecommunications and general Communications projects. All UNI-LAB Management are comprehensively familiar with the use of PERT, CPM and other computerised monitoring systems.

The successful on-time completion of any major project relies on the application of the correct planning and control techniques. UNI-LAB consistently achieves this aim. Experience and expertise are all part of the UNI-LAB package. From design through to commissioning.

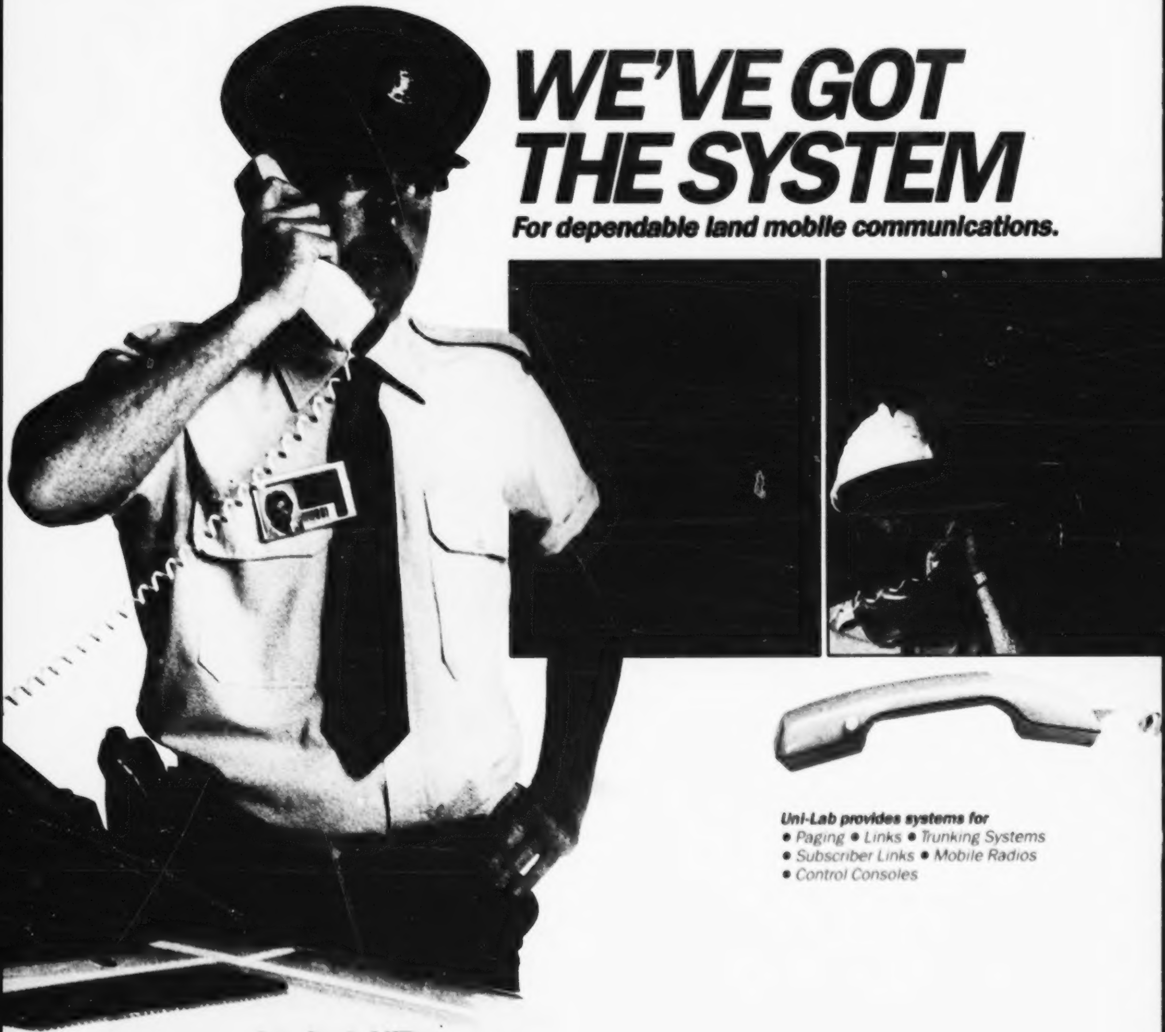
By reaching out UNI-LAB has brought the world a little closer.

TELECOMMUNICATIONS

Project Management
System Design & Evaluation
Civil Engineering
Installation & Commissioning
Maintenance
Proprietary Equipment
Surveys
Training

REACHING OUT TO THE WORLD

[illegible] Beach Road, Osborne Park, Western Australia [illegible]
Telephone [illegible] Telex [illegible] Fax [illegible]



WE'VE GOT THE SYSTEM

For dependable land mobile communications.

Uni-Lab provides systems for
- *Paging* • *Links* • *Trunking Systems*
- *Subscriber Links* • *Mobile Radios*
- *Control Consoles*

Police Security & Military
The highest quality communications equipment is mandatory for reliable operations. The KU series not only offers reliability but ease of installation and servicing with reduced down time.

SSB UL324B Left

The Concept

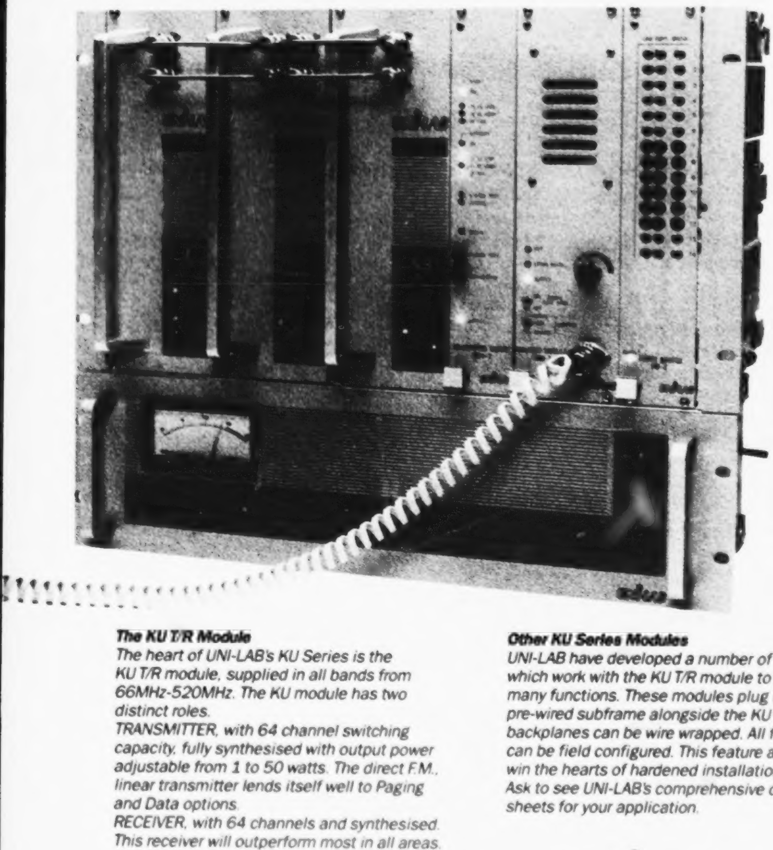
The UNI-LAB KU Series Modular VHF/UHF basestation was designed and built by Engineers who have had considerable practical experience in the installation and maintenance of complex communications systems.

The KU Series not only offers the modular concept but also a unique redundancy feature. By designing a common transmit/receiver module, redundancy is built in. That is, use one module as a repeater transmitter and another identical module as the receiver and you have a spare in each. Simply swap modules and the spare is brought into service.

UNI-LAB offers a large range of options modules which can be configured to form basic or sophisticated basestation and repeater systems.

Options:

- 50-200 watt PA Modules
- CTCSS and 5 to 32 Tone Sequential Signalling
- Voice Plus Data Branching
- Full Duplication Changeover Modules
- Directional Couplers and Turn-around Mixers
- Diplexer Modules
- Auto Testing and Supervisory Modules
- Technician Access & Monitor Modules
- Patching/Jackfield Modules
- Community Repeater Modules
- Line Interface Modules
- Paging Interface & Control
- Active Hybrids
- VF and Logic Matrix Modules
- Fan Cooling Modules (for 100-200W PA's)
- Full range of Mains Power Supplies
- d.c.-d.c. Converters



UNI-LAB TELECOM

The KU T/R Module

The heart of UNI-LAB's KU Series is the KU T/R module, supplied in all bands from 66MHz-520MHz. The KU module has two distinct roles.

TRANSMITTER, with 64 channel switching capacity, fully synthesised with output power adjustable from 1 to 50 watts. The direct F.M., linear transmitter lends itself well to Paging and Data options.

RECEIVER, with 64 channels and synthesised. This receiver will outperform most in all areas.

Other KU Series Modules

UNI-LAB have developed a number of modules which work with the KU T/R module to perform many functions. These modules plug into a pre-wired subframe alongside the KU T/R. Rear backplanes can be wire wrapped. All features can be field configured. This feature alone will win the hearts of hardened installation staff. Ask to see UNI-LAB's comprehensive data sheets for your application.

UNI-LAB
TELECOMMUNICATIONS LTD

REACHING OUT TO THE WORLD.

459 Scarborough Beach Road, Osborne Park,
Western Australia, 6017.
Telephone: (619) 444 9855. Telex: AA 96245.
Fax: (619) 444 9663.

SSB UL 324B Right

WORLD CLASS TOTAL SOUND SYSTEMS

THE ALTEC LANSING 50 YEAR SOUND EXPERIENCE

Altec Lansing Corporation is the world's pre-eminent supplier of fixed installation sound systems. For over 50 years, our products have been the choice of many of the world's great stadiums, arenas, auditoriums, theaters, airports, convention centers, houses of worship and government installations. We are the world's sound specialists.

Altec Lansing is the only major company who can offer you the total sound system concept. This means we manufacture all of the components you need to design and install any size fixed installation system. You get all of the technical data and replacement parts you need from one company. But just as important, you own a system with each component engineered to work together as a total system. Your sound system is easier to design, operate and maintain. The name Altec Lansing stands for quality products you can depend on for outstanding performance.

Altec Lansing has manufactured the sound systems for world class arenas, such as Osaka-jo Hall in Osaka, Japan, and the Olympic Stadium in Montreal, Canada. Our total sound concept can be heard in the Meadowlands sports complex in New Jersey, USA.

Great theaters have specified Altec Lansing to entertain millions. And international hotel and convention centers, including Marriott, rely on our quality and dependability. We have also manufactured the sound systems found in houses of worship around the world.

Government installations, industrial complexes, even entire cities can now provide warnings and emergency information by using Altec Lansing's Giant Voice system. Giant Voice replaces warning sirens, whistles and bells with the human voice allowing you to give clear, concise instructions instantly over wide areas.

We manufacture sound systems that are available for any size installation. From small paging systems to international airports and teleconferencing systems to giant soccer stadiums, Altec Lansing's sound ideas and equipment make your system the very best.

Our worldwide distribution network is made up of professional sound contractors ready to design, install and provide service for your system. This network includes many of the most respected international sound professionals, all of whom have earned the right to offer you Altec Lansing systems.

You can be confident your system is the best when you specify Altec Lansing. From the construction of each component to system design and installation, technical support and replacement parts, Altec Lansing and our professional sound contractors stake our reputations on every sound system. That's why such demanding customers as America's National Aeronautical and Space Administration (NASA) specified Altec Lansing for the Kennedy Space Center at Cape Canaveral, Florida.

Sound is our only business. Altec Lansing brought sound to motion pictures and since that time, we have received more patents and published more technical papers than any other company in our industry. While we stay on the leading edge of technology, we also support our systems with technical manuals and replacement parts dating back 30 years and more.

Altec Lansing Corporation has a reputation for engineering and manufacturing only the finest components so you never have to compromise your sound system's quality or dependability. Contact us at Altec Lansing. We can supply you with information and the name of the authorized distributor serving your country.

Altec Lansing... We Build World Class Total Sound Systems.

ALTEC LANSING®

P.O. Box 26105 • Oklahoma City, Oklahoma 73126 USA • 405-324-5311 • Telex 160369 • Distributors Worldwide

ALTEC
LANSING

the sound of experience.

1 147

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PROFILE OF TELETTRA ESPAÑOLA, S. A.

TELETTRA ESPAÑOLA, S. A., an industrial company with a highly innovative spirit and a strong commitment to export, a workforce of 1.893, including a significant number of university graduates, and a business volume which in 1986 is expected to reach US$ 100M, is the result of the agreement between two large groups of companies to pool their historical, economic and technical prestige. The capital stock is split as follows:

- ☐ Compañía Telefónica Nacional de España 51 %
- ☐ FIAT International, through TELETTRA SpA 49 %

TELETTRA ESPAÑOLA, S. A., besides using technology developed by TELETTRA SpA, has its own strong research capability with which to extend the range of products it offers. It devotes considerable human and technical resources to the development of new products, and current research and development expenses represent a substantial percentage of sales.

TELETTRA ESPAÑOLA, S. A., operates basically from its three large manufacturing plants in Spain, where it is a leader in the telephone transmission and other telecommunications applications market. Its presence abroad is also considerable as may be confirmed by satisfied clients in over 40 countries to whom TELETTRA ESPAÑOLA, S. A., has exported more than 20 per cent of its total sales in the last years.

With its determination and capability to be an international leader in the development of RURAL TELEPHON SYSTEMS and a wide range of equipment installed throughout the world, TELETTRA ESPAÑOLA, S. A., possesses production and quality control facilities capable of supporting the most ambitious ventures.

Together with the wide range of products and services offered, TELETTRA ESPAÑOLA, S. A. has both the technical and economic weight and degree of flexibility that enables it to undertake a wide range of projects in the telecommunications field, offering high-quality solutions in the required time.

PRODUCTS AND SERVICES OF TELETTRA ESPAÑOLA, S. A.

Transmission systems. Multiplex and line

- Frecuency division multiplex up to 3.600 channels.
- Time division multiplex up to 7,680 channels (565 Mbit/s).
- Analog and digital multiplex for sound program channels.
- Transmultiplexor.
- Analog line equipment on coaxial lines up to 10,800 channels.
- Digital line equipment on coaxial lines up to 7,680 channels (565 Mbit/s).
- Optical fiber line equipment up to 7,680 channels (565 Mbit/s).
- FDM and TDM telegraph equipment.

Radio-link systems

- Analog systems up to 2,700 channels.
- Digital systems up to 1,920 channels.
- Baseband and IF changeover equipment.

Low capacity transmission and distribution systems. Rural telephone systems

Low capacity transmission and radio-link systems

- Analog multiplex up to 60 channels.
- Digital multiplex up to 120 channels (8 Mbit/s).
- Analog line equipment on cable pairs up to 24 channels.
- Digital line equipment on cable pairs up to 30 channels.
- Optical fiber line equipment up to 120 channels (8 Mbit/s).
- Analog radio-link equipment up to 120 channels (400 and 900 MHz).
- Digital radio-link equipment (30 and 60 channels) (0.9/1.5 and 2.4 GHz)

Low capacity distribution systems

- Radio multiple access system (96 subscribers/8 or 16 channels; 150 and 400 MHz).
- Single channel radio equipment for voice and/or data (150 and 400 MHz).
- Digital multiple access system (128 and 256 subscribers/30 channels; 1.5 and 2.4 GHz) for speech and data.
- 1 + 1 equipment on subscriber line for voice and data.
- Symmetrical concentrators (96 subscribers/16 channels).

Mobile radiocommunications systems

- Base and repeater stations VHF/UHF.
- Coded messages transmission equipment.
- Mobile and portable VHF/UHF equipment.
- Common frequency systems equipment.

Data transmission systems

- Low and medium speed modems.
- Data modems over B.B. up to 2 × 2 Mbit/s for analog radio-link and coaxial systems.
- Baseband modem (48 to 72 Kbit/s).
- Data multiplexors for PCM networks up to 2 Mbit/s.
- Distributed Multiplexors.
- Subscribers Multiplexors.

Subscribers systems and terminal equipment

- Subscriber side line equipment.
- Exchange side line equipment.
- Alarm transmission equipment.
- Telephone call diverters.
- Equipment for videotext systems.
- Electronic funds transfer terminals.
- Authorization and transfer electronics funds terminal.
- Multitransaction Authorization Sub-system.
- Bussines terminal.

Telephone exploitation aid, supervision and remote control systems

- Subscriber's lines maintenance systems.
- Telephone traffic measurement systems.
- Remote maintenance systems for rural networks.
- Centralized and decentralized telephone charging systems.
- Supervision systems for communication networks.
- Control and management of electric networks and fluid distribution systems.

Power supply systems

- Single phase modular battery chargers up to 25 A (24/48 Vcc and 220 Vca).
- Theree-phase modular battery chargers up to 75 A (48 Vcc).
- Solar energy station.
- Up and Down converter for battery chargers to 48 Vdc.

Defence communications systems

- Strategical communication networks (analog and digital radio-link systems, VHF, UHF, multiplex equipment, etc.).
- Tactical communication networks (HF mobile equipments –400 W– an HF fixed equipment –500 and 1.100 W–).

Services

- Site surveys; Project design; System desing; and supply of infraestructures (civil work, towers, power plants, etc.); Turn key engineering; System installation and setting up; Technical assistance; Maintenance, repair and spare parts; Trainning and documentation.

RURAL COMMUNICATION

TELETTRA ESPAÑOLA, S. A., has developed and implemented the rural multi-access system for rural applications (analog and digital). This solution offers many alternatives to the **rural telephony** problems, with the optimum use of the radio spectrum. The system configuration allows a technical and economical adaption for the whole telephone densities range and the traffic demands in rural areas.

Its modularity permits an economical equipping for smaller capacities. The system technical parameters meet the CCITT, CCIR, CEPT recomendations.

Telettra Española S.A.

C/. Raimundo Fernández Villaverde, n.º 65 - 28003 MADRID - Tel. 456 30 93 - Telex 22485 - Fax 4562415

TELETTRA ESPAÑOLA AND RURAL TELEPHONY

A great number of countries and governments aware of telecommunications importance are increasingly using this means as a base for their social and economical development.

The communications are not a mere privilege, but a right to use efficiently the limited resources. Therefore, the implementation of modern telecommunications services in remote areas with economical and geographical difficulties in order to integrate them in the Public Telephone Network, is a challenge not only for the administrations but for the users as well.

The telecommunications are one of the main factors helping the economical growth and the industrial expansion. Although it is very difficult to determine the interrelationship of these two concepts, the effects are positive and result in a better quality of life.

On these premises, it is not surprising that our society attempts, among other concerns, to expand the services offered by the telecommunication network to reach peripheral, rural or low population density areas.

The heading **rural communications** embraces many things which range from remote communities in rural districts through to high density residential and industrial locations which are placed well away from normal traffic areas. Some of these may be destined for long term development while others are established to exploit short term situations, yet both demand the best that telecommunications has to offer.

As a solution to this reaction, man and science have entered into a symbiosis to develop what is called **rural telephone systems.**

Telettra Española, S. A., with its determination to find adequate solutions to meet each problem, has developed the multiple access radio systems, both analog and digital, for rural applications, based on its experience gained throughout the years in this enterprise. Furthermore, the adoption of new techniques and the most advances technology have led to the development of highly reliable and economical equipment, and the system has also been provided with good operation, supervision and maintenance facilities.

Systems allow simple connection to the most diverse telephone switching systems and satisfactory solves the problems posed by the frequency planning.

In conclusion, the rural multiaccess systems offers a wide range of technical and economical alternatives for any type of traffic densities and demands of the rural areas. In this way, small remote communities of important urban nuclei are linked with the country's main communication paths, enjoying the benefits provided by the technological developments.

Men, technology and countries gather together to create a new more communicated, more efficient and, in all, a better world.

Telettra Española S.A.

C/. Raimundo Fernández Villaverde, n.º 65 - 28003 MADRID - Tel. 456 30 93 - Télex 22485 - Fax 4562415

TELEMATICS, DATA TRANSMISSION, SUPERVISORY AND EXPLOITATION AID

TELETTRA ESPAÑOLA, aware of its professional and business endowment, also directs its efforts to the same route and way as the social evolution. Therefore, as a result of the user-service relationship dynamic and deep study, a great emphasis has been place on information because it is deemed as the path to a "BETTER SOCIETY".

In this respect, and with the vivid mind and hopes that inventiveness requires, we assign research and development resources, as well as improved production activity, to fields such as telematics, data transmission, supervisory and exploitation aid.

The above mentioned activities purpose is to develop new communication networks and new services, where user's facilities, simplicity and cost savings will be the base for its growth.

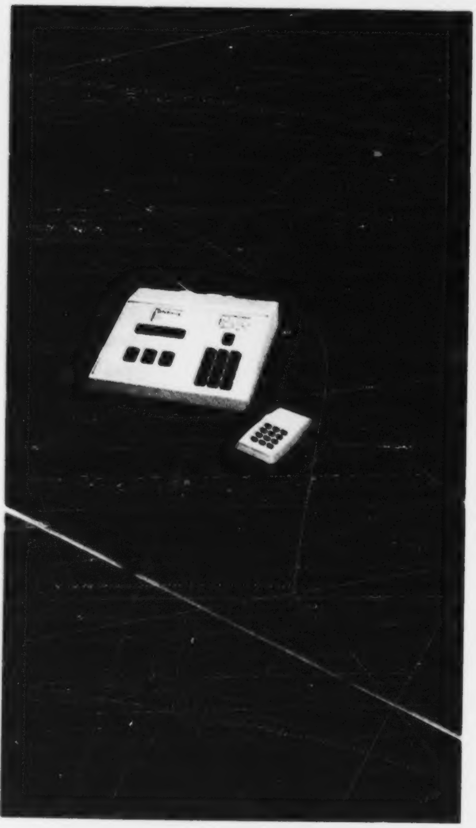
The use of high integration circuits, masked circuits, microprocessors and semi-custom circuits features our products developed.

In the telematics field, TEPV terminals and multi-transaction authorization sub-systems are Telettra's contribution to electronic funds authorization and transfer, as are TNIS TERMINALS to THE VIDEOTEXT SYSTEM.

The new data transmission networks evolution have required us to develop new philosophies and equipment. In this regard, new distributed multiplexers and subscriber base band modems, supported by semi-custom circuits and using the new signal digital processing techniques, have appeared.

Finally, and as a result of our system experience, as well as to our capability to offer complete and whole solutions, there is our constribution to supervisory, maintenance and exploitation aid, materialized today with SSP and PDLA systems.

Professional integrity, creativeness and service is the message to our customers.



THE USER-FRIENDLY TELEPHONE SYSTEM

IN THE rosy world of the office of the future, the corporate executive will at last be able to get back to his true job — meeting his economic targets without having to spare a thought for the mechanics of administration. Helped by integrated business communications systems like the ITT 5200 BCS, he will be able to concentrate on what he is communicating and not how.

The ITT 5200 BCS has just chalked-up more than 1,000 orders and is soon to be found in 34 countries. It is the fruit of a two-year development project by ITT Austria (today Alcatel Austria — Europe's Number One in Telecommunication!) and consists of a digital PABX system in which voice, data and image can all be simultaneously carried by a single cable. This system is part of the growing trend towards narrowing the gap between computer data and other forms of inter-office communication. It is also the in-house extension of the much heralded ISDNs or integrated services digital networks, that will by the 1990s have transformed most public telephone networks.

In the old days, computers lived in splendid isolation and most executives would gingerly approach an expert operative when they wanted to know something. Today the same executive may well have his own PC among the forest of high-tech accessories on his desk.

And his need for fast, flexible information has grown, as has his company's need for a new breed of senior manager who cannot only look after the confusion of growing networks, but who can also plan their integration in the future.

The world's leading telecommunications companies are well aware of this problem; there is still an enormous educational gap to be bridged. And much will also depend on the awareness of local dealers. Alcatel Austria's product marketing manager, Werner Böhm explains "If you try to sell a complete business communications system in the US, the typical customer asks if it has data switching capacity. Fifty per cent of them ask if they can have a telephone and terminal on their desks at the same time — and ten per cent go ahead and order this capacity immediately. In Europe," he goes on, "less than half even enquire about data switching capacity. We really have to tell people here about the new machines that can help them to reach new levels of development."

The ITT 5200 BCS was, indeed, developed largely as the result of pressure from the marketplace. It was originally conceived as a small digital PABX system of from 30 to 100 lines that would be suitable for the domestic Austrian market. It was born out of the conviction of a group of ITT engineers in Vienna that, like so many of their competitors, there were in the 1980s no longer selling products that were relevant to the future.

Once the 5200 project was under way, however, sales representatives from far-flung outposts of ITT began turning up in Vienna, all with the same message: "We need a digital switching system to sell — and we need it now". During the system's development phase, the ITT team twice doubled the size of the 5200, so that it can now be used for up to 700 extensions or a thousand ports.

At present, most of the 5200's customers are using the system as a straightforward telephone network. Customer interest in developing the system's full potential depends to a very large extent on the enthusiasm and the technical awareness of local dealers. In Taiwan and Hong Kong, for example, there is much more interest in the 5200's data applications than in most other markets around the world.

So what is a typical customer for the 5200? "The system" says Werner Böhm, "is suitable for any type of business. A hotel chain, for instance, would have very different needs to a stockbroker so we offer different specifications to suit individual needs."

In addition to the simple transmissions of data through the network, interfacing with the established base of terminals, the multipurpose terminals which can be connected to any point of the end-user's existing telephone system. These new services include teletext, videotext, electronic mail, file management and word processing and they can either run on a cluster or integrated service units or on a remote host-computer.

The voice and data streams can be directed in-house or to outside systems, which allows a very considerable flexibility for user needs. And because these needs are involving so quickly, flexibility has been the key factor in this design of integrated networks. The same flexibility has also contributed towards the 5200's cost-effectiveness, because it does not over-provide capacities for executives who do not need them — or, as in some more chauvinistic countries, executives who refuse to have a keyboard on their desks "because that sort of thing is women's work". A look at the United States market, however, gives some idea of the changes the rest of the world can eventually expect.

By 1990 there will be over 100 million remote terminals with access to computing power and there will also be an increasing trend towards PCs in the office environment. The amount of processing power in the US is currently doubling every year.

At the same time, the digitalization of the PABX systems both in the office and outside is paving the way for very advanced communications services. There are signs, too, that telephone and computing systems are converging and may before very long become indistinguishable from one another. American distributors, for instance, are beginning to handle both. The old worry about which was more important — voice or data — is already irrelevant now that there are networks that treat both alike.

"'To us, the office of the future is a continuum", explains Werner Böhm. "That is why the integration of networks is so important. It gives flexibility and scope for development that will keep pace with the users' needs. Desks are for the time being getting more and more encumbered with wires and machines and every time an executive wants another piece of hardware he has to re-wire his office. But this won't be necessary," he adds, "for people who make use of the one network that is already so widely established — the telephone. We see the manager of the future sitting at a tiny workstation, a single compact unit that provides him with all the information he needs without overwhelming him with technology. And on top of that, he won't be tripping over wires the whole time!" □

Why Chase Manhattan Jakarta chose the ITT 5200 BCS.

Alcatel Austria make this world-class system. Chase Manhattan chose it because it's efficient, economic, easy to install and even easier to use. The fifth reason was the convenience of Alcatel's international sales and support organisation. This not only guarantees trouble-free operation, but also ensures that help is immediately on hand for capacity and capability upgrades. Upgrades that are already bringing the digital information technologies of the future into the office of today. That's five very good reasons for taking a close look at the ITT 5200 BCS. And doing so is very simple, just contact your local Alcatel office.

The Chase Manhattan Bank of Jakarta, Indonesia, have installed an ITT 5200 BCS with seven trunk lines and 64 extensions. Networking with a second office is planned. The system will enable the bank to provide an even better service to their private and corporate customers in the fast-growing Indonesian economy.

ITT 5200 BCS

Performance plus local presence make this Business Communications System a worldwide success

Alcatel Austria
Aktiengesellschaft
A-1211 Vienna
Tel.: +43 222 38 00 0

Alcatel

TELECOMMUNICATIONS EQUIPMENT

COST-EFFECTIVE TRANSMISSION

COAXIAL OR FIBRE OPTIC LINES?

by Patrice Desombre

Cable installation can be the greatest single expense involved in setting up a transmission network. In cases where financial resources are limited and yet international communications are a high priority, the choice of transmission lines needs careful consideration. Patrice Desombre General Manager of the Landline Systems Division of Alcatel CIT, evaluates the relative merits of coaxial and fibre optic cables for wideband longdistance transmission.

THE purpose and direction of national development are best served when the nation's long-distance communications facilities, such as highways and railroads, are designed for compatibility with their counterparts in neighbouring countries. However, in the specific case of telecommunications, each nation should view itself as 'next door' to every other country on earth. In order to develop a transmission network that is truly costeffective and oriented towards future development needs, planners should begin by matching their traffic formats to those used by the most advanced telecommunications establishments.

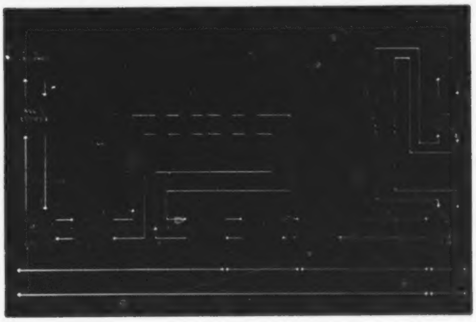
In many cases, developing nations are already equipped for a degree of long-distance and international communication. Such facilities often rely on analogue-based systems to support small- to mid-size groupings of telephone channels. The first part of this article recommends an evolutionary programme for modernising an existing plant of this type. The second presents a plan for new installations.

Agreements for compatibility

Use of the term 'standardised' in connection with communications equipment refers to the Recommendations of the Consultative Committee on International Telegraph and Telephone (CCITT), an agency of the United Nations, which advises user nations on technical and tariff questions in international telecommunications. CCITT Recommendations, published every four years, cover every aspect of solid-media telecommunications, e.g. frequency allocations for analogue multiplexing and line groups; bit rates and functions for digital multiplexing; and cable sizes. Manufacturers adhere to CCITT Recommendations to ensure international market qualification for their products. Operating authorities follow CCITT Recommendations to ensure uniformity of network management practices and charging rates.

Contemporary traffic

Communication links are vehicles for transporting information-bearing signals, the most common forms of information being:



***Above:** Conversion to digital operation involves replacing the analogue multiplex (MUX), line terminal (LT) and repeater units with their digital counterparts, which offer improved cost-effectiveness ratios. In addition, when the local-end signal is digital, the need for the digital conversion segment, i.e. three multiplexers and a line terminal, is eliminated.*

***Above:** Step-by-step frequency translation, or the analogue multiplexing technique, assembles information-bearing signals by 'stacking' them into progressively wider envelopes of carrier frequencies. Digital multiplexing assembles bit streams by sequentially fitting samples of information into time slots of progressively denser concentration. In both cases, receive-side processing involves the same steps, in the inverse order.*

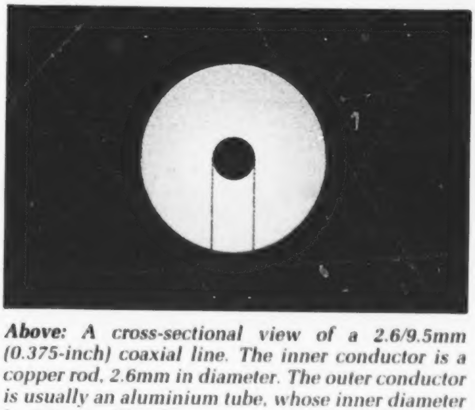
- ☐ voice, also called POTS, for Plain Old Telephone Service;
- ☐ data, ranging from telex to facsimile transmission of documents; and
- ☐ images, ranging from freeze-frame video teleconference to high-resolution colour television broadcasts.

Below: *In this link between a major city and a distant terminal, a station serves a small town and a rural area via a composite bit stream of 140 mb/s (i.e. 4×34 mb/s). Atthe drop/insert station, the television bit stream is supplied to the rebroadcast facility (radio or cable) and regenerated for follow-on transmission. One of the telephony bit streams is fully demultiplexed to provide local telephone and data services towards both terminal stations; the other two bit streams are routed through, for use elsewhere.*

Analogue traffic

Voice traffic is the most common service and the reference value in world telecommunications. A telephone dial tone indicates the availability of one voice-frequency (VF) channel, carried by a pair of wires connected to the local telephone exchange. The bandwidth of a VF channel is 4,000 Hertz (Hz).

Data traffic is by nature digital. Data can be carried by telephone circuits if the density of information (also called 'bit rate', 'data rate' or 'speed') can be adapted to VF bandwidth. For analogue transmission, special equipment units called 'modems' and 'analogue multiplexers' perform this task. For data traffic exceeding the bandwidth of one VF channel, the operating authority rents standardised blocks of channels, e.g. 12-channel groups, 60-channel supergroups and 300-channel mastergroups.

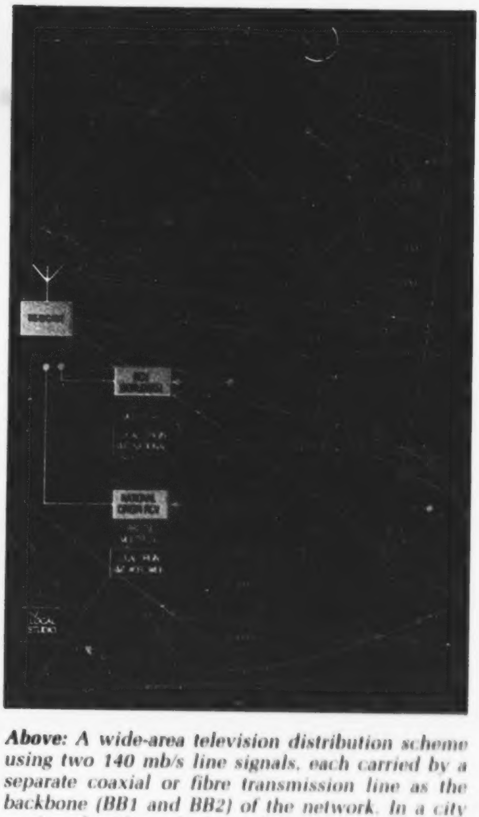


Above: *A cross-sectional view of a 2.6/9.5mm (0.375-inch) coaxial line. The inner conductor is a copper rod, 2.6mm in diameter. The outer conductor is usually an aluminium tube, whose inner diameter is 9.5mm. Signals are propagated in the space between the conductors.*

Image traffic occupies large blocks of bandwidth, e.g. the video portion of a standard television picture is equivalent to 1,500 VF channels or a 900-channel supermastergroup plus two mastergroups.

Digital traffic

For digital transmission, the concept of bandwidth is replaced by that of bit rate. To enable digital transmission of naturally analogue information such as voice and images, digital systems convert these to data form,



Above: *A wide-area television distribution scheme using two 140 mb/s line signals, each carried by a separate coaxial or fibre transmission line as the backbone (BB1 and BB2) of the network. In a city equipped with a telephone/data exchange, a television rebroadcast facility and a television studio, the local administration can enjoy full international communications.*

including the pitch, tone and quality of the speaker's voice and the grey or colour shadings of images. Having converted all information to data pulses, the equipment provides a continuous flow of time slots, at standardised bit rates, to transport the data. At the receiving end, matching equipment reassembles each set of pulses and reconstructs the original messages.

Line signal composition

Analogue line groups are assembled by successive stages of frequency-based multiplexing, i.e. single channels or blocks are electronically 'stacked' into a single wideband signal; support signals (e.g. remote fault location and remote power feed) are added; and the line group is fed to the cable.

Digital bit streams are assembled by multiplexers based on time division and information theory. Analogue-based information is sampled, the samples are assigned values, which are represented as 8-bit data 'words', and these are interleaved to form a standardised bit stream. Two or more bit streams can be assembled to attain higher bit rates, i.e. better cost-effectiveness.

Long-distance transmission

A standardised long-distance link via solid media can cover up to 2,500 route kilometres (1,560 route miles) between terminal stations. Such links must use appropriate standardised coaxial or fibre optic transmission lines. Radio media, such as microwave and satellites, conform to separate sets of Recommendations which are set up and published by the Consultative Committee on International Radio (CCIR).

Repeaters

As an information-bearing signal moves along a transmission line, it dissipates power and suffers distortion due to characteristics that are inherent in the line. To overcome these losses, a cable link uses repeaters at standardised intervals along its route. Analogue repeaters amplify the wideband line group; digital repeaters produce new bit streams, based on the original's information content. Repeaters must be packaged for direct burial or pole mounting. Cases for buried repeaters are watertight, corrosion resistant and impervious to attack by animals or machines.

Digital conversion

The first step in setting up a cost-effective transmission plant is to convert existing transmission links to digital operation, even if the rest of the network remains analogue based. Among the immediate benefits of such conversion are greater efficiency and higher reliability. Moreover, the receiving ends of these links will be freed of the need for equipment to convert the formats of incoming signals at sensitive interface points. Digital-based equipment occupies less space, is cheaper to operate, simpler to maintain and immediately adaptable to all contemporary signals, i.e. voice, data and images. For these and other reasons, industrialised nations are installing digital systems in all new plants and steadily upgrading networks by replacing analogue links. Existing CCITT-recommended coaxial cables can be re-used.

Coaxial transmission lines

A coaxial cable consists of one or more coaxial transmission lines, the required electrical shields (also called 'screens'), one or more service pairs, one or more layers of armour (if needed) and an outer jacket, usually of polyethylene. Aerial cable sections include a messenger, i.e. a separate steel support cable, sealed into a separate part of the outer jacket, running parallel to the associated transmission lines.

A single transmission line consists of two concentric conductors whose significant dimensions are standardised. These dimensions set the cost-effective limits of line operation and are used to designate the line itself.

CCITT-recommended coaxial lines

Two coaxial lines are used in almost all high-capacity analogue networks worldwide: 1.2/4.4mm (0.375 inch) and 2.6/9.5mm (0.5 inch). A recently-developed line, 3.7/13.5mm (½ inch) is in use on some 'electronic highways', supporting up to 10,800 VF channels. Line operation costs are closely related to the number of repeaters required to maintain the integrity of the information being carried. As shown in Table 1, the carrying capacity of a line can be tripled by doubling the number of repeaters, i.e. halving the space between each pair of repeaters.

Economic aspects

A cost-effectiveness trade-off is indicated in

Table 1

TABLE 1 Relationship of Coaxial line sizes to Repeater Spacing and Distribution

SYSTEM CAPACITY (standardised bit rates in megabits per second (mb/s))	REPEATER SPACING per cable size				REPEATERS PER 100km (62.5mi)	
	1.2/4.4mm		2.6/9.5mm			
	KM	MILES	KM	MILES	1.2/4.4mm	2.6/9.5mm
34	4	2.5	9	5.6	25	18
140	2	1.25	4.5	2.8	50	22
565	Inadvisable		1.5	0.97	N/A	67

NOTE: 3.7/13.5mm (½ inch approx.) lines, developed for 10,800 VF channels, and applicable to 565 mb/s, offer repeater spacing of 1.85km (1.16mi) i.e. 54 repeaters per 100 route km

160

Table 1, i.e. bit rates versus line size and the number of new repeater installations necessary to maintain effective operation on an existing line. For most developing nations, a line bit stream of 140 megabits/second (mb/s), as an assembly of four separate streams of 35 mb/s each, is advisable. This arrangement can offer two television channels plus 960 telephone/data channels.

At 140 mb/s, an existing 1.2/4.4mm line is at the limit of its capabilities: upgrading a 100km link to 565 mb/s would shorten the repeater spacing to 1km or less, and the costs associated with the new repeaters would be uneconomical. Above 140 mb/s, 1.2/4.4mm cables should be replaced with fibre optics.

New links

On both economic and technical grounds, new long-distance links should ideally be built around digital systems operating at 4 × 34 mb/s or 140 mb/s streams. These bit rates will offer total service capabilities. Moreover, the equipment can be upgraded simply and economically to meet future growth needs. The preferred transmission medium for such links is fibre optic cable.

With the appropriate equipment installations, an operating authority can provide:

☐ telephone services throughout a nation and worldwide network access;

☐ access to data-based services worldwide; and

☐ complete television service. Programmes can be received via satellite and distributed to rebroadcasting stations nationwide. Programmes can also originate at any studio or mobile television unit for both nationwide distribution and retransmission via satellite to any place equipped to receive them.

In almost every significant area of comparison, the properties and characteristics of fibre optic lines are superior to those of coaxial lines. Table 2 offers some comparative evaluations.

Conclusion

For a developing nation, the upgrading or installation of a long-distance transmission network is a double opportunity. From a practical viewpoint, efficient transmission serves the nation's business community by opening world markets to its agricultural and industrial products. It can also encourage foreign investors to consider extending their operations into the nation, perhaps even to the extent of setting up regional headquarters there.

Worldwide access to data banks provides information resources, advances education and encourages development by the nation's own citizens. From a cultural viewpoint, it should be evident that only a communicating nation can occupy a full place in world society. Television capabilities enable government and citizens alike to learn what other nations are thinking and doing. Most of all, they enable the nation to orginate its own programmes and make itself known to the world.

TABLE 2. Evaluation of Coaxial and Fibre Optic Cables

CHARACTERISTICS AND PROPERTIES	COAXIAL	FIBRE
BIT RATES	34, 140, 4 × 140 mb/s	nx34, nx140 mb/s n = any number, 1 to 16
CHANNEL CAPACITY	Depends on cable	No effective limit
REPEATER SPACING	2KM, typically	40km, approximately
DROP/INSERT FACILITIES	Only between two terminals connected back to back	Specific Drop/Insert facility
REMOTE FAULT LOCATION	Line by line, without backup capability	Station by station, including environmental control, line and laser backup, aids maintenance of service channels and remote control functions
REMOTE POWER FEED	Via the line itself. Power takeoff at each facility on the line	Local power stations, e.g. solar preferred, because metal conductors are not normally present, remote power feed would need dedicated wire pair
SUSCEPTIBILITY TO ELECTRICAL INTERFERENCE	Yes, parasitics and lightning	No, because fibres neither radiate nor absorb electrical energy
EASE OF FIELD MAINTENANCE	Standard tools and instruments	Special equipment, e.g. optical instruments and fibre splice kit required
GROWTH POTENTIAL	Limited by cable characteristics, upgrading requires new terminal stations and additional repeaters	Unlimited for cable, minimal equipment modifications, by exchange of circuit boards

Table 2

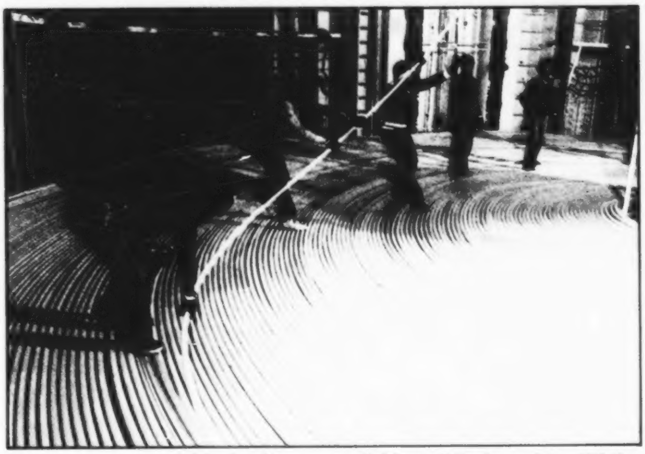
Careful planning, supported by technical understanding, is vital to the cost-effective success of telecommunications development. A transmission network is the middle portion of the route followed by a message from the calling party to the party being called. As such, transmission capabilities must be matched to their counterparts at the other end of the link. Eventually, these capabilities must be made available in developing nations, i.e. digital switching and fibre optics in local networks.

Existing facilities must therefore be upgraded to digital-base operations. If coaxial cables are already available they can be re-used for digital plant, thereby deferring the major expense of laying new cables. The money freed by this deferment can be used to purchase the necessary digital systems. For new plant, fibre optics cables are the most forward-looking investment, because their virtually unlimited capacity will enable an operating authority to meet any mid-term future needs. ☐

The author is indebted to Arthur J Schwartz who, on behalf of Suprocom Sarl, Paris, participated in the preparation of this article.

COPPER CABLE STAYS THE COURSE

by Thomas D Morocco



Cable loading on a Cable & Wireless ship. While current interest is focused on fibre optics, it should not be forgotten that copper cable can also meet the needs of digital communications both in terms of speed and efficiency. Photo courtesy of Cable & Wireless.

The latest developments in fibre optic technology are being watched keenly by the telecommunications industry, especially as the move to the integrated services digital network (ISDN) becomes more of a reality. Yet copper cable can meet the needs of digital communication both in terms of speed and efficiency. Thomas D Morocco, Field Project Manager, Applications Engineering, for the Network Products Division of the General Cable Company, puts the case for proven technology which should not be forgotten in the rush for something new.

THE VISION of integrated services digital network (ISDN) has widened the eyes of the telecommunications community. Ironically, however, there appears to be a misconception that for end-to-end digital connectivity, ISDN can only be implemented on fibre optic cable systems.

Based upon the International Consultative Committee on Telegraph and Telephone (CCITT) and Exchange Carriers Standards Association (ECSA), two standards of access for ISDN have been adopted: basic access 2B+D and primary access 23B+D. Both of these systems can be implemented over copper cable now being used in the local loops and inter-office trunks.

Basic ISDN

The transmission of data in the basic rate 2B+D, as defined by the CCITT, can be a varying bit rate from 75 bits/second up to 144 kilobits/second (kb/s). Technically speaking, 2B+D means there are two 64 kb/s B channels for transmitting voice or data and one 16 kb/s D

Table 1: Cable types and their carrier applications

cable	*gauge*	*carrier type*	*average repeater separation*	*data rate*	*loop length*
PIC/Pulp	19,22,24	T1*	5,000ft	1.544 mb/s	about 50 miles
		T1C**	6,000ft	3.152 mb/s	about 50 miles
PIC/Pulp (two cable operation)	19,22,24	T1	7,000ft	1.544 mb/s	over 50 miles
		T1C	8,000ft	3.152 mb/s	over 50 miles
D-shield	19,22	T1	6,000ft	1.544 mb/s	over 50 miles
		T1C	7,000ft	3.152 mb/s	over 50 miles
Dual-D screened	19,22	T1	8,000ft	1.544 mb/s	over 50 miles
		T1C	9,000ft	3.152 mb/s	over 50 miles
Genspan	16	T1	25,000ft	1.544 mb/s	over 50 miles
		T1C	27,000ft	3.152 mb/s	over 50 miles
		T2	NA	6.312 mb/s	19,000ft
		T3	NA	44.736 mb/s	4,500ft

*Not recommended for cables with less than 100 pair.
**Not recommended for cables with less than 900 pair.

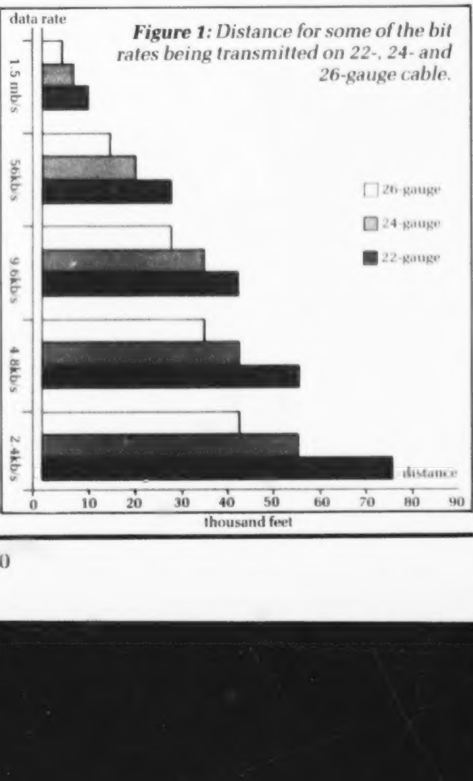


Figure 1: *Distance for some of the bit rates being transmitted on 22-, 24- and 26-gauge cable.*

channel for signalling the network, giving a combined digital signal of 144 kb/s.

The transmission of data at a rate of 144 kb/s over copper cable is nothing new in the telecommunications industry. High-speed data communications equipment, with synchronous or asynchronous modems, has been exchanging data using the V standards set by the CCITT for many years. For example, a V.37 modem transmits data at a rate of 96 to 168 kb/s which exceeds the 144 kb/s range for ISDN basic access. The distances that some of the standard bit rates can be transmitted on 22-, 24- and 26-gauge cable in the local loops are shown in Figure 1. The only restrictions applicable to using these distances is that all cable pairs must be unloaded.

Primary rate

Primary rate 23B+D means there are 23 B channels and 1 D channel, each consisting of 64 kb/s, to be used for voice and data, giving a combined digital rate of 1.544 megabits/second (mb/s). The CCITT agreed upon this rate because it can and is being implemented over copper cable using T1 digital carrier facilities. The majority of the inter-office trunks and trunks to large businesses today use such digital carrier facilities. Another system widely used in the telecommunications community is the T1C system which transmits data at 3.152 mb/s over twisted pair copper cable.

Primary ISDN can be implemented with T1 or T1C carrier facilities over copper cable using any of the following cable transmission systems.

One cable operation – In a one cable operation using plastic insulated or pulp insulated cable, both directions of transmission share the same cable and the same line repeater unit. Because low level repeater inputs and high level repeater outputs appear at the same point in the cable, near-end crosstalk occurs, which is the limiting factor in repeatered line design. The number of systems that can be installed in a single cable is mainly controlled by the physical separation of the pairs in the two directions. This means, for economic reasons, that standard type cables of less than 100 pair in size are not recommended for carrier application.

Two cable operation – In a two cable operation using plastic insulated or pulp insulated cables, separate cables and separate line repeater housings are used for each direction of transmission. Near-end crosstalk is not a limiting factor in the two cable operation and this means that any size cable can be used.

D-shield cable – A D-shield cable, which allows for a one cable operation, has an insulated metallic shield separating pairs for the two directions of transmission. Near-end crosstalk is greatly reduced as a limiting factor and so any size cable can be used. D-shield was designed for primary rate transmission of 1.544 mb/s T1 carrier spans.

Dual-D screened cable – A dual-D screened cable is a one cable operation, which provides transmission properties equivalent to those afforded by two separate cables, thus effectively eliminating near-end crosstalk as a limiting factor. This allows maximum repeater spacing using any size cable. Dual-D screen was designed specifically for T1C 3.152 mb/s and is also capable of transmitting T1 carrier.

Genspan cable – A Genspan cable is a one cable operation using twisted pair wires for transmission. It can be applied to T1, T1C, T2 and T3 digital multiplexers and digital carrier spans. Genspan cable, because of its low loss, can be applied in some applications with no span line repeater units between the two terminal ends.

Conclusion

Basic ISDN – Technologists proposing digital transmission for the local loops will have to find some method of converting analogue voice to digital transmission at the subscriber location. When they have achieved this, the twisted pair copper cable that is already serving the subscriber is the only medium needed to provide basic ISDN transmission.

Primary ISDN – The changeover from analogue to digital transmission in public telephone networks did not begin two years ago with the introduction of ISDN, nor did it begin with fibre optics as many would lead us to believe.

Since the early sixties the T1 carrier systems (1.544 mb/s) have become the predominant means of providing a variety of services in the exchange areas over copper cable from 100 pairs to over 3,000 pairs. Starting in 1975 the T1C PCM digital carrier system (3.152 mb/s) was introduced, which also operated over copper cable. The first digital switch was only put into operation in the early eighties.

Clearly, data was being exchanged over copper cable at rates that exceed the CCITT ISDN standards before the introduction of fibre optic cable systems or, for that matter, before the digital switch itself was incorporated into the telecommunications industry. □

163

LOOKING AHEAD WITH OPTICAL FIBRE

by Nick Medlam and John Harrison

Increasingly, optical fibre transmission is being considered as an attractive proposition by PTTs both financially and technologically. Nick Medlam, Managing Director of Focom Systems International, and John Harrison, formerly of Focom Systems Ltd, examine its advantages for local wideband communications in particular.

REAL-TIME communications traffic, including video, audio, voice and data, is currently placing demanding design requirements on the engineers concerned with specifying system components. The number of data bases situated in remote locations around the world is increasing dramatically and new modes of communications such as teleconferencing and electronic mail are rapidly becoming available. Existing transmission facilities are facing a potential overload situation as attempts to accommodate these new services are made.

The application of optical fibre technology to new long-distance telecommunications trunk networks is universal in the United Kingdom and pre-eminent in the rest of the world. The compelling factor for implementing optical fibre in such an application is the price/performance benefit obtained by users/operators: the PTTs. The primary source of the benefit is enormous bandwidth, and low attenuation (reduction in strength) coupled with small size and low weight, all readily available from optical fibre systems.

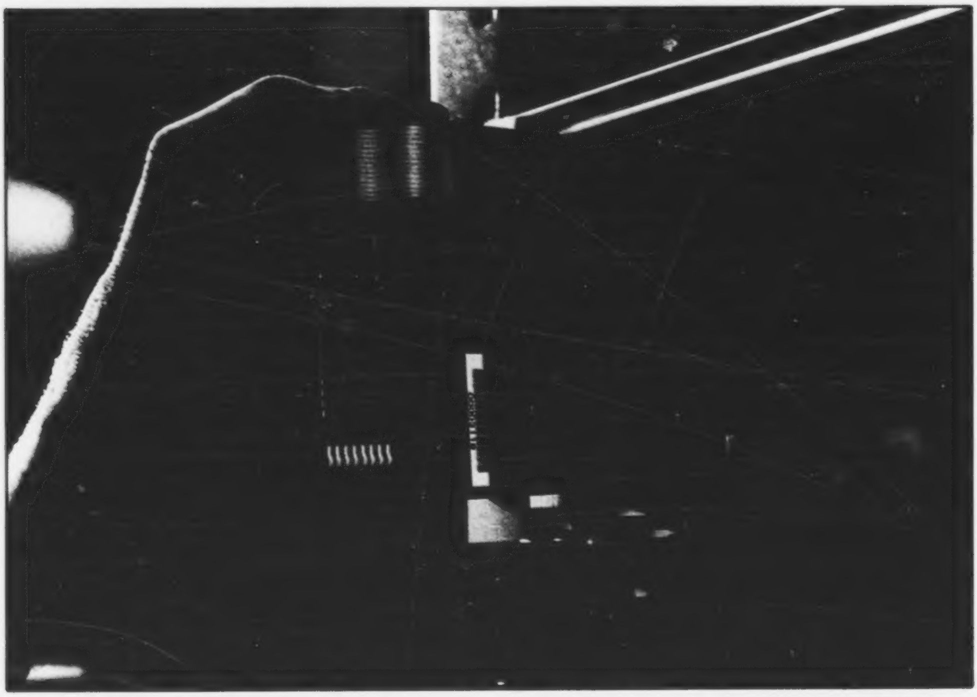
The application of optical fibre in communications of a local nature is almost the antithesis of the above, with the market very much in its infancy but growing steadily. However, there is an immediate cost motivation for users/operators to implement optical fibre in local communications, with estimates suggesting that between 60 and 70 per cent of all voice, data, text and video information is transmitted over distances of less than 5km before it is processed in some form or other, e.g. switched, multiplexed-demultiplexed, displayed, etc.

There are obvious inconsistencies in the required price/performance parameters for telecommunications and local communications which need to be rationalised and optimised in favour of the latter. The essential issue to be addressed for the local solution is the reduction of price to the user/operator, without necessarily reducing the performance parameters of the link; with the possible exception of distance. Because the optoelectronic terminal will make up the majority of the costs in the local solution, this represents the major area for cost reductions.

The advances in fibre optics which are continually being made are providing the practical technology to establish cost-effective communications for the future, as well as the solutions for the information congestion problems of today.

History

The first single-wire communications link covering a significant distance was successful-



Section of a 1600 Series multiplexer showing 'card' type units.

ly demonstrated in the last century. This achievement laid the cornerstone of the communications industry which we see around us today. Since that event, various communications systems have evolved, from low information capacity baseband signal links through VHF and UHF to microwave and now optical fibre communications systems. These systems present a progressively more efficient use of the communication media for mass information transfer.

In 1968, K C Kao discovered that the losses in pure fused silica (the first optical fibre material) near the infra-red region were less than 20 decibels/kilometre (dB/km). It was subsequently proposed to use fibres of this material for long-distance communications and later work has resulted in the fabrication of optical fibres with losses ranging down to 0.2 dB/km, dispersion down to 2 picoseconds/nanometer per kilometre (ps/nm.km) and bandwidth distance products up to 50 gigahertz/kilometre (GHz/km). Fibre optics is now in a position to dominate the communications industry. It offers an efficient transmission alternative to present-day metallic cable and microwave modes of communication.

Until recently, the microwave link had provided the most cost-effective solution to long-haul, high information capacity channels by virtue of its ability to carry different combinations of narrowband and baseband signals. In applications requiring wide bandwidths over short distances, conventional metallic cables have been used. This situation is changing as fibre optics now provide systems with cost/performance benefits across a wide spectrum of applications. The inherent attributes of fibre make it ideally suitable for high-performance, high information capacity links in which the link capacity is limited by the electronics, not by the transmission medium itself.

From the late 1970s a number of companies have specialised in the design, manufacture and marketing of these low cost opto-electronic terminal equipments for use in local wideband communications systems.

Local communications

In defining local wideband communications, 'local' is considered to be an area limited by the range of unrepeated transmission. In the context of currently available commercial products, this means individual link distances up to 20km which may be configured into physical rings with circumferential distances of hundreds of kilometres.

In applying transmission media to communications applications, the bandwidth limitation of twisted copper pairs precludes this medium from serious consideration as a wideband carrier. Discounting this, the relative utilisation of the other media (coaxial, fibre and microwave) is shown in Figure 1, relating link distance to practical implementation in recent years.

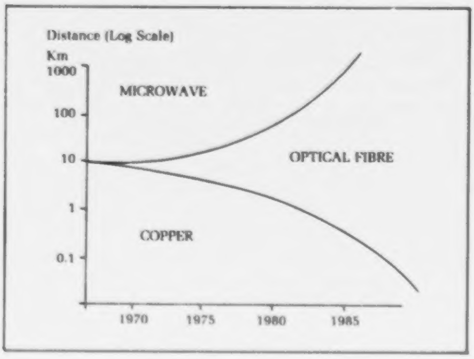


Figure 1: Relative use of coaxial, fibre and microwave media in recent years.

The justification for selecting each transmission medium will have considered the principal parameters of choice: cost, performance, flexibility, reliability, etc. The graph shows the spreading acceptance of optical fibre installations as the cost/performance benefits of fibre optics have improved.

There is a tendency for many of the systems provided for the local wideband communications market to parallel those implemented in the long-haul telecommunications optical fibre market. The two applications both combine optical fibres with digital circuitry in order to provide communications systems with high bandwidth, easy switching and flexible service. In order to reduce costs by one, or even two, orders of magnitude for the local systems, components/modules are selected for the needs of the market. Typically, light emitting diodes (LEDs) replace lasers and large core, multimode optical fibres (graded index and step index) replace single mode fibres.

A current application of the generic solution is to adopt time division multiplexing (TDM) techniques to provide transmission of multiple channels of information over a duplex optical fibre cable without the numerous problems associated with copper transmission. TDM provides a convenient method of generating a serial data stream which will be used to binary modulate the infra-red light source, in this case the LED. Large core fibres (50/125 micron graded index or, more usually, the 200 micron step index) provide a low loss transmission path for the infra-red light to compatible optical receivers of the positive intrinsic negative (PIN) or avalanche photodiode (APD) variety. The optical receiver will convert the serial light pulses back into an electrical format ready for demultiplexing. Optoelectronic terminal equipments of this nature can support distances from a few metres up to five kilometres.

Wideband system costs

The cost of any communications system, whether local or trunk, can be subdivided into different parts for analysis. The more detailed the subdivision, the more contentious may be the analysis. Therefore, to reduce argument, only thee principal and very significant subdivisions are presented in Table 1.

SYSTEM COST SUB-DIVISION	% OF TOTAL SYSTEM COST
Physical medium, (coax, cable, optical fibre cable or microwave antennae)	15 – 20
Medium installation (trenching towers)	35 – 40
Everything else	50 – 40

Table 1: Analysis of system cost sub-division

Historically, the installed physical medium has had a first generation life of between 30 and 50 years and a second generation life of between 20 and 30 years. The current demand for more information capacity, which is being satisfied by the provision of wideband services, requires the installation of the third generation.

Given that the installed cost of the physical medium is the predominant part of the total system cost (between 50 and 60 per cent), it is of paramount importance to install a medium which may serve the third generation demand with every likelihood of serving the fourth generation as well. Fibre offers that possibility.

Current fibre capability

Virtually any combination of information formats can be carried on fibre. Both analogue and serial data information can be frequency modulated on to a wideband RF signal which is used to intensity modulate the transmitting device. This technique allows the simple integration of data, voice, fax, radar, audio and video and many other information formats. Therefore, at the local level, it is now possible to provide a fibre-based integrated services link without recourse to expensive digitisation of analogue signals.

Local data applications

For many years now, large commercial organisations and their information based departments have had a growing number of requirements, which are dependent on the interconnection of geographically widespread units. The advent of personal computing in the form of networked PCs or mainframe terminals is increasing still further the need for communications cables between floors, buildings and sites. Two fibre based products to reduce the size and number of cables in these data communications applications are outlined below:

RS232/V24 multiplexer – This type of multiplexer is a simple point-to-point multichannel transmission product, capable of supporting up to 32 channels of full duplex data in asynchronous or synchronous formats. Each RS232/V24 channel supports two nominated modem control signals as well as data and synchronous clocking information.

The multiplexer will support all channels transmitting at 19.2 kilobits/second (kb/s) and the TDM generates a 5.25 megabits/second (mb/s) serial data stream. The multiplexer is well suited for computer room to user office area distribution in high rise office blocks as well as interconnecting adjacent buildings on large sites.

RS232/V24 data network – A distributed data switch provides comprehensive networking of RS232/V24 permanent virtual circuits (PVCs) over optical fibres.

A single network comprises any number of data nodes in a ring configuration up to a maximum of 30. Each data node can support up to 16 RS232/V24 connections, with a fully loaded ring being able to support 480 such connections. The PVCs can be either dedicated (determined by a centralised network controller) or flexible (controlled by the asynchronous terminal user's keyboard). In either case a maximum of 240 PVCs can be established at any point in time. The 240 PVCs all support four nominated modem control signals as well as data and synchronous clocking information and can operate at bit rates up to 19.2 kb/s. The TDM produces a serial data stream of 8.6 mb/s. Since all the data nodes can be positioned up to 5,000 metres from each other, single ring networks covering geographical areas approaching 50km in diameter can be achieved.

Multiple rings can be integrated for larger data communications requirements. The equipment will support V35 and X21/V11 interfaces at bit rates up to 76.8 kb/s as well as RS232/V24 interfaces. The typical application for this kind of network is the inter-networking of numerous office block complexes in an inner city area.

Wide area applications

Business subscriber loops and relatively short distance junction networks have also obtained price/performance benefits with the application of optical fibres. The increasing need for bandwidth for data and full video and the limitations of the historically installed copper cable schemes have led to the development of wideband optical equipment.

FM modulated analogue transmission equipment – By employing broadcast quality, but conventional, FM techniques for the combination of multiple signals, it is possible to use the wide bandwidth of a laser diode-based optical transmission system. Equipment which allows the transmission of up to 16 video channels and 32 audio sub-channels using one single-mode fibre for unrepeated distances up to 20km has now been developed and manufactured. Either the audio sub-channels or the main channels may be used for frequency shift keying (FSK) encoded serial data streams to provide fully integrated services links. The system provides a flat response 500 MHz pass band which can be used as described above or for radar and broadcast intermediate frequency (IF) signals with frequency stacking for multiple signal applications.

2, 8 and 34 mb/s G703 optical line termination equipment (OLTE) – This equipment allows the user/operator to substitute the copper media with optical fibres and thus realise the superior operational parameters inherently available from such systems.

The majority of the OLTE units produced to date have been designed for use with 50/125 micron, graded index multimode optical fibre: a standard telecommunications junction fibre for use at the first or second window. An additional generation of OLTEs for use with single mode optical fibre is currently under development. The single mode OLTE had initially proved cost prohibitive, until the availability in quantity of low-cost single mode LED pig-tailed devices from component suppliers.

Future issues

The transmission of voice, data, text, video and other information in future years will consume more and more bandwidth as the number of information based systems increases and the requirement to include real-time features becomes the norm. Real-time features, such as full motion video and high speed/high volume file transfers, are already evident in systems with computer aided design (CAD), central processing unit (CPU) networking and expert databases.

ISN or ISDN? – Users, engineers and PTTs are working towards the provision of integrated services digital networks (ISDN). The argument for the provision of an integrated services network (ISN) is overwhelming but the need for that network to be digital should be challenged.

An inherent feature of a network is that it should be switchable. Digital electronic switching is faster, more reliable and cheaper than analogue electronic switching. Because of the low bandwidth of speech, it is simple, reliable and cheap to digitise the voice signal. For these two reasons the PTTs are accelerating the introduction of digital telephone networks. However, these reasons for digitisation are not so cogent when considered in the context of integrated wideband service networks.

The relative advantage of digital switching over analogue is being eroded by technological advances. The cheap and easy digitisation of speech does not apply to video and other high bandwidth signals (vide: the cost of 70 megabit and 140 megabit codecs to convert analogue signals to digital). Therefore future ISNs should not necessarily be digital.

Optical capability – Of all the developments in optoelectronics which are being pursued in the research laboratories, the most significant is likely to be the optical switch. Ericsson is already supplying 16-way optical switches operated electronically. The emergence of the photonic, multi-way switch operated optically is not very far in the future. This emergence will make optical analogue switching comparable with electronic digital switching and will provide the highest performance, most cost-effective integrated services networks.

Fibre capacity – Today's practical fibre systems are all using single wavelength transmission. Laboratory and test systems are already proving the feasibility of multiple wavelength operation for both simplex and duplex communications using wave division multiplex (WDM) techniques. Further WDM developments will lead to at least four, and possibly 16, times the bandwidth capacity being available as from today's technique.

Research activities – Many other areas of optical fibre technology are now the subject of intensive commercial research and development programmes, specifically aimed to fulfil the future needs of users/operators in local wideband communications.

The user/operator can expect increased price/performance benefits as a consequence of the growing marketplace with economies in the volume of mass-produced units combining with competitive sources of supply.

Some of the major price/performance milestones now in laboratory development and expected to be available for commercial applications in two to three years' time are listed below:

☐ A standard single mode optical fibre: a low cost optical fibre for use in all local and wide area wideband communications, with a bandwidth measured in 10s of GHz.

☐ Coherent transmission: very high bandwidth transmission techniques.

☐ Flexible techniques for optical fibre installation: installation and recovery procedures to allow changes in demand to be met quickly.

Conclusions

If users/operators of local wideband communications systems today are experiencing price/performance penalties and sometimes non-viability with the copper transmission medium, then there is a strong case for advocating the application of optical fibres to all local wideband communications systems. The users/operators could then have all the bandwidth and transmission performance required to meet the demands of information transfer, today and tomorrow.

This is not to suggest that users/operators should pre-invest in bandwidth and transmission performance that they might never require in practice for 10 to 20 years, but they should consider the long-term installation of high performance optical fibres and the expedient installation of terminal equipment sufficient to realise the bandwidth and transmission performances required at that date. They may then change the terminal equipment retrospectively to meet their new demands with speed and ease.

In an environment of ever increasing technological change, any decision should seek maximum protection of an investment. The installation of a fibre transmission medium offers the greatest likelihood of utilisation over the longest period. ☐

169

POWER LINE CARRIER SYSTEMS FOR DEVELOPING COUNTRIES

by Tomas A Blet

Integrated system evaluations of power lines can take much of the guesswork out of power line carrier installations. Tomas A Blet, Applications Engineer for Westinghouse Electric Corporation, Relay and Telecommunications Division, explains the groundwork necessary for the successful installation of a multi-channel telephone carrier system.

POWER line carrier (PLC) telephone systems have been applied to 50/60 Hz power transmission lines since the early 1920s, but not until remote meter reading and distribution automation appeared in the 1970s was PLC applied to electrical utility power distribution lines. With the introduction of the multi-channel single side band PLC telephone carrier system in the 1980s, former techniques were made obsolete and new challenges emerged for the communications engineer in the area of line treatment. A computer program has been developed to help engineers in the design and installation of line treatment components to allocate them into the communication network formed by the distribution line.

This telephone carrier system consists of two terminal ends, each equipped with up to 12 audio channels for voice or data communication. The 12 audio channels are placed on the power line over a frequency range from 12 to 136 kHz, using specially designed PLC line traps, coupling capacitors and line tuners. Each voice channel can provide single party service or up to five party service with fully selective bridged ringing for each subscriber. Signalling may be dual tone multifrequency (DTMF) or rotary. Two-wire or four-wire terminations are available.

Installation of these carrier systems can be performed in a single day, bringing a service to areas where communication is difficult, impossible or expensive by conventional means.

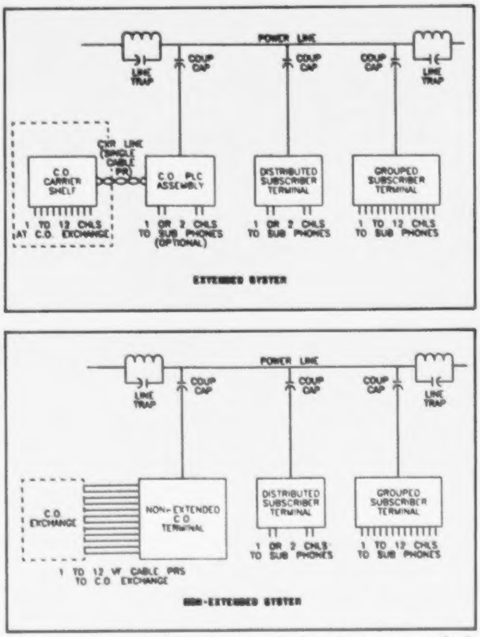

POWER LINE
LINE TRAP
COUP CAP
COUP CAP
COUP CAP
LINE TRAP
C.O. CARRIER SHELF
CXR LINE (SINGLE CABLE PR)
C.O. PLC ASSEMBLY
DISTRIBUTED SUBSCRIBER TERMINAL
GROUPED SUBSCRIBER TERMINAL
1 TO 12 CHLS AT C.O. EXCHANGE
1 OR 2 CHLS TO SUB PHONES (OPTIONAL)
1 OR 2 CHLS TO SUB PHONES
1 TO 12 CHLS TO SUB PHONES
EXTENDED SYSTEM
POWER LINE
LINE TRAP
COUP CAP
COUP CAP
COUP CAP
LINE TRAP
C.O. EXCHANGE
NON-EXTENDED C.O. TERMINAL
DISTRIBUTED SUBSCRIBER TERMINAL
GROUPED SUBSCRIBER TERMINAL
1 TO 12 VF CABLE PRS TO C.O. EXCHANGE
1 OR 2 CHLS TO SUB PHONES
1 TO 12 CHLS TO SUB PHONES
NON-EXTENDED SYSTEM

Figure 1: Comparison of extended and non-extended multi-channel PLC systems.

Two basic configurations, extended and non-extended, are available.

The extended configuration, shown in Figure 1, locates the single side band transmitters and receivers at the central office (CO) end. A single pair from the CO carrier shelf to the distribution pole cabinet carries the channel radio frequencies to be multiplexed through the amplifier and line coupling assembly located on the power line pole. At the remote end of the power line is a grouped subscriber termination from which all channels are dropped.

Figure 1 also shows the non-extended grouped carrier configuration. At the CO, the voice channels are multiplexed over a common amplifier and coupled to the power line. In this self-contained configuration, all equipment is contained in the CO and separate pairs are connected for each voice channel. At the subscriber end, all channels are demodulated at one termination location, as in the extended system.

The figure also shows the distributed carrier configuration. The CO cabinet for the distributed carrier may have an extended or non-extended arrangement. The cabinets containing the distributed terminals are installed, using the same type of coupling capacitor assembly at different locations along the power line. With the distributed carrier configuration, the subscribers may be dropped in one or two channels, voice or data.

The basic configurations differ in their complexity but, in all cases, each terminal is connected to the distribution power line by a coupling capacitor assembly, as shown in Figure 2.

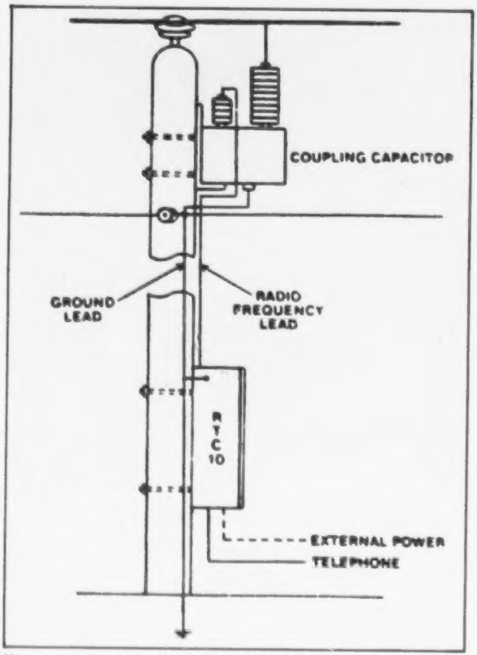


Figure 2: Connection of multi-channel carrier system to power line via coupling capacitor assembly.

Pre-installation information is collected in order to determine, from computer program analysis, how many of the 12 possible channels operate satisfactorily. The telephone company must supply all information concerning the telephone configuration and services required and the electric utility must supply a complete description of the power distribution system on which the equipment will operate. The manufacturer's personnel coordinate with the telephone and electric utility company personnel and make the evaluation of the line and the equipment selection.

The telephone company determines whether to use central office group extended or central office group non-extended equipment, whether the subscribers are grouped or distributed, and the number of voice channels desired and/or required in the application.

The electric utility provides information on the configuration of the power distribution system. Every component (fuse, switch, transformer) and its location must be spelled out. Every tapped line and, whether or not it is terminated, must be described in detail. How long is the tap? How many phases are involved? Is the tapped line open-ended? Is it terminated in a transformer? Describe the transformer (single or double bushing, single-phase or three-phase, kilovolt amp (kVA) rating, etc.). Normally, a one-line diagram of the power distribution system, with all up-to-date revisions, is recommended as an ideal vehicle to transmit this portion of the required data.

Two questions must be answered before the line evaluation and equipment selection can be completed:

- ☐ What is the frequency response of the power distribution line?
- ☐ Can the lines be treated and yield a low enough loss between the transmitters and receivers?

Without the input data and computer program, the answers could only be determined at the time of installation. With the computer program, data files can be created that describe the lines, transformers and estimate the line treatment components. Output data files describe the frequency response of the line(s) involved and the total loss between the transmitter and receiver. The output files do not include any noise data for subsequent signal-to-noise ratio (SNR) calculations. The noise values used in the performance SNR calculations come from either measured data or the values obtained from typical noise curves.

A description of a test case will demonstrate the correlation between the computed response and the actual field measurements. The basic system configuration utilised consists of the non-extended configuration with various distributed subscriber terminals. Figure 3 shows the power distribution system's one-line diagram. The non-extended CO terminal is shown at location A and distributed subscriber terminals are shown at locations B, C and D.

All measurements were taken at position D. If the measurements had been taken at positions A, B or C, the frequency response would be similar. The final treated power distribution system has line traps (T1, T2) and inductors (L1 through L7) installed at the locations shown in Figure 3.

Several graphs are used to document the line responses from a 'no treatment' stage (Figure 4), progressively through the treatment stages (see Figure 5 as an example of an accumulation of several treatment stages), to the final 'computer treated' stage (Figure 6). The actual measurements were taken by inserting a noise

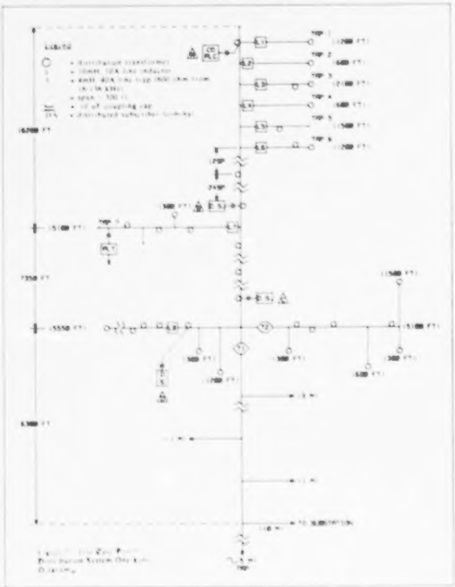


Figure 3: Test case power distribution system one-line diagram.

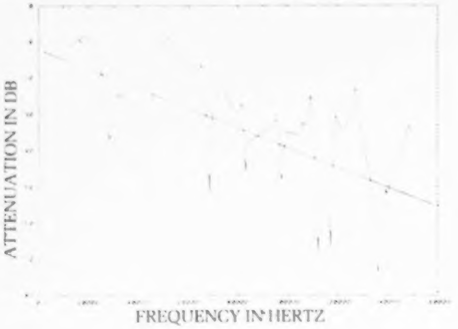


Figure 4: Frequency response test case: untreated lines.

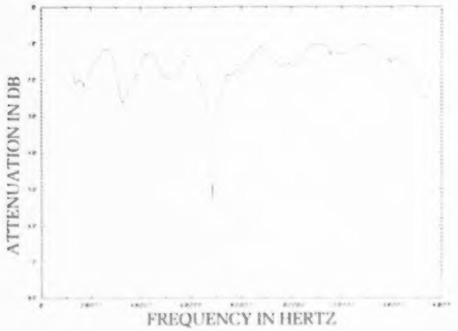


Figure 6: Frequency response test case: usable line treatment.

Left and Below: *Prerequisites for the installation of Power Line Carrier Systems vary according to geographical location and local needs. Once these have been established, however, the installation, itself, is a swift process and brings a service to difficult areas where conventional methods have been inappropriate.*

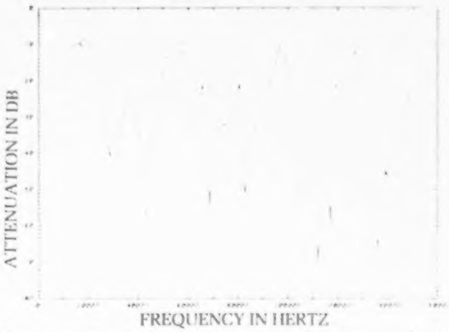


Figure 5: Frequency response test case: partially-treated lines.

generator through a 10 W amplifier tuned to the line's impedance and measuring the received signals with a spectrum analyser at the subscriber locations. Pictures of the analyser's stored output were taken and an attempt has been made to represent these pictures in the graphs shown (Figures 4, 5 and 6). Each figure shows a photo of measured data together with the graph containing the computer output for the same condition as the photograph.

Figures 4, 5, 6 and 7 indicate how adding line treatment inductors/line traps affects the frequency response of the line. Figure 4 shows a widely variable attenuation pattern around an average attenuation slope going from approximately -10 dB to -55 dB. None of the channels can be used with this condition. As inductors L1 through L5 are added (Figure 5), the erratic response is not effectively altered. A pole at 98 kHz is removed when L3 is added, and the attenuation slope is beginning to lessen. The short taps with inductors L1 (900 ft), L2 (600 ft), L4 (600 ft) do not affect the response as much as treating the longer taps with L3 (2,100 ft), L5 (1,200 ft), L7 (5,100 ft) and T2 (6,300 ft). If the line treatment were to stop at the conditions shown in Figure 6, various channels could not be used. However, if an inductor (L8) is placed in the line to the left of the distributed subscriber at 'D', the large discrete frequency attenuation at 68 kHz (Figure 6) will disappear.

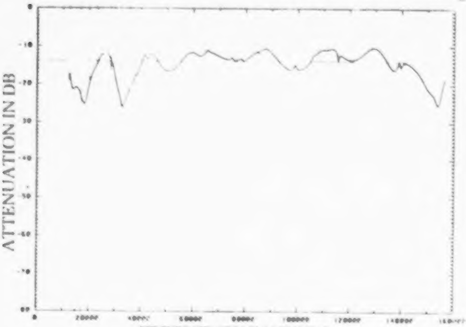


Figure 7: Frequency response – treated line.

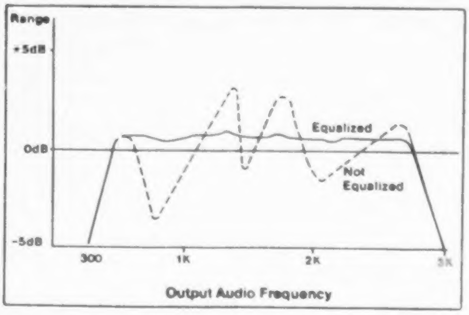


Figure 8: Audio equalization.

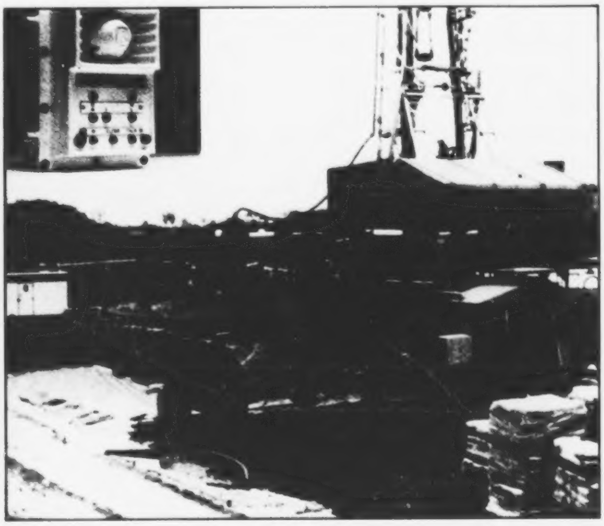
When all measurements are taken, the frequency response should be the same as for the conditions shown in Figure 7. Only channels 5, 7 and possibly 6 cannot be used due to the attenuation within the channel bandwidth. To compensate for this non-linear attenuation with varying frequencies of power lines, the equipment has the innovation of audio equalisation. Figure 8 shows an enlarged portion of the treated line frequency response over the audio bandwidth of 300 to 3,000 Hz. The unequalised dotted line (audio) shows a variation of 3 to 4 dB across the audio bandwidth. The audio equaliser can correct this variation to within ± 1dB, providing the solid equalised line. The audio equaliser range is ± 5 dB. There are compandors after the equalisers which double the effective variation correction and allow a total of 10 dB attenuation slope in the power line being used.

The use of channels 1 and 2 depends on the line noise present. In the case of the 12.5 kilovolt test line, typical line noise vs frequency curves show the noise at 12 and 16 kHz to be -34/-14 dBm and -35/-15 dBm, respectively. If both channels (1 and 2) are voice, and compandors are used, the SNR will be >50/30 dB in fair/adverse weather in channel 1 and >50/32 dB for channel 2. These are good PLC SNR values.

How much improvement is achieved is not easily detected with the addition of inductors L1 to L8 to the untreatd power line. A practical procedure demands a reverse analysis of the treated power line. Using the one-line diagram of Figure 3, while removing L1, with inductors L1 to L8 and traps (T1 and T2) mounted on the line, a small variation in the frequency response of Figure 7 is detected. This means that L1 can definitely be removed from the power line with subsequent cost savings.

This is the process that must be considered with each multi-channel telephone carrier system. If good input data is obtained, the evaluation will yield the number of channels that can be used and the SNR values which can be expected.

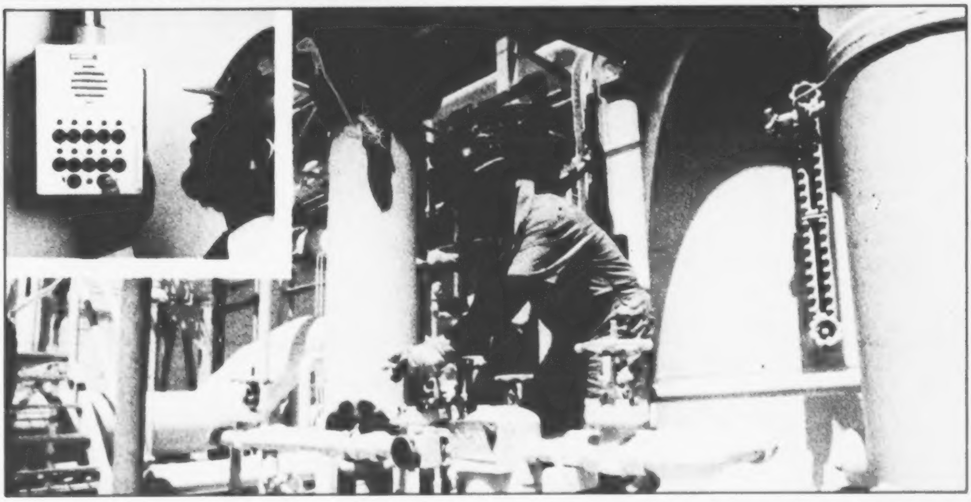
Not every installation will use 12 channels, due to the final frequency response of the system's power line and the noise encountered. If 12 subscriber channels are truly needed, and they are grouped, then from two to four trunk circuits to the subscriber location may serve the subscriber better. Only the telephone company itself can determine alternate solutions which can be implemented. □



INTERCOMS FOR EVERY ENVIRONMENT

by Dick Parata

Conditions in developing countries can range from extreme temperature changes to dangerous thunderstorms. Dick Parata, General Manager of Barkway Electronics, a UK manufacturer of intercom systems, explains how equipment is designed to cope with all possible hazards.



Top left: *New heavy duty intercom stations designed to withstand hostile conditions and rough treatment. Ease of use is another priority.* **Top right:** *Intercom equipment being used in a hazardous area such as an on-shore oil rig could prove a safety risk in itself unless absolutely explosion proof.* **Above:** *Local control points connect to a central control point so that the status of remotely located equipment can be relayed instantly to the control room.*

TELECOMMUNICATIONS EQUIPMENT: INTERCOMS FOR EVERY ENVIRONMENT

A RELIABLE intercom system is often regarded as the ultimate development in speedy direct communications in commerce in the Western world. But in developing countries, such systems may need to play a far more rugged and basic role.

In particular, there is a pressing need for high-speed communications during the 'infrastructure' stage of development, when power stations and hydro-electric and, if it is applicable, oil or gas exploration schemes, are brought 'on stream'.

On an oil exploration rig in a tropical environment, for example, there could well be a combination of hazards, including dust, corrosive salt spray, drenching monsoon rains, searing heat by day and penetrating cold by night, and the constant risk from explosions and damage to the electronics by lightning. Through it all, the intercom system, as a vital means of communication, will be expected to remain functional.

An added factor in such a naturally hostile environment is that an intercom must be totally 'user friendly'. Not only will it have to contend with non-technical staff who want a simple-to-use direct link with their control point, but it may have to be used in an emergency, when reliability and ease of use are vital.

It may also be essential to record vital information being transmitted. As a result, an intercom station may need to be linked in to a data logger voice recorder which, in the case of off-shore platforms, may mean providing a link to recording equipment on shore.

The most important criterion is the design of the intercom 'enclosure', or casing. This has to bear the brunt of both a hostile environment and heavy-handed treatment. New developments in this area have led to the design and manufacture of aluminium casings which are explosion proof, to meet the standards of the British Approvals Service for Electrical Equipment in Flammable Atmospheres (BASEEFA), and may also be required to be air- and water-tight.

As an illustration, an intercom system in a liquid petroleum gas plant could prove a hazard in itself. One small spark from any electronic equipment could cause colossal damage. To prevent this, the casing to house each intercom station has to be incapable of causing an explosion.

Most process control intercom configurations feature a central control point connected to various remote locations, such as monitoring gauges, around the plant. Key positions are visited regularly by operatives to give instant status checks to the control room, and verify the accuracy of remote instrumentation.

The need for instrumentation is important, but more visual checks by operatives using efficient communication systems could arguably have helped to avert a disaster such as that at Bhopal, by alerting staff sooner of a critical condition.

Chairman of Barkway, Geoffrey Chapman explains, 'It is important that equipment which is being supplied at plant operative level is simple to use. You are not expecting someone to start reading directories or operating instructions as you might with hospital or military personnel.

'If people have an emergency, they don't want to spend valuable time finding out how to use communications equipment. They want to be able to use the most simple controls to connect them automatically to a point where people can take immediate action.'

Over the years products have been developed to cope with a number of hazards not normally found in some more equitable climates. For instance, on an oil exploration project in the South China Sea, the Japanese company Hitachi found that dust was clogging Retimet flame-arrestor material which allows the passage of sound inside the explosion-proof casing. To overcome this, small filters were developed with retaining plates, which allowed them to be removed easily for cleaning.

Keeping water out of enclosures is, of course, necessary on oil rigs, and other off-shore activities. Intercoms for use in these circumstances must achieve an Ingress Protection rating of IP65, if not IP66 (the highest possible rating being IP68). But a further problem is encountered in tropical countries where humidity can be 80 or 90 per cent. Cadmium-plated metal fasteners rust within 24 hours, and so stainless steel or nylon must be used.

A further market for integrated intercom systems in developing countries is likely to expand as new hospitals are constructed. Security and military applications also have to be taken into consideration, with the result that intercom systems may now be tailored to meet any specific requirements.

Research has not stopped there, however, for high-security intercom systems using fibre optics are now in production. These will eventually be useful in coping with both security and freedom from electro-magnetic pulsar (EMPs), the most common form being lightning damage, which is also a hazard in a number of developing countries. □

MORSE MAKES A COMEBACK

by Bob Surtees

With the arrival of satellites and computers, most people consider that Morse code is old-fashioned and probably obsolete. Bob Surtees, Sales Manager of Morse Equipment Ltd, explains how the Morse signal of ordinary dots and dashes is still an internationally used method of communication.

WHEN people think of morse code they usually imagine a soldier in a first World War trench tapping out his message on a Morse key. But many would be surprised to hear that Morse was used by the forces during the Falklands conflict. Although neglected for many years in favour of more sophisticated telecommunications equipment, Morse is experiencing a revival, not only for military use, but in a surprisingly diverse range of situations.

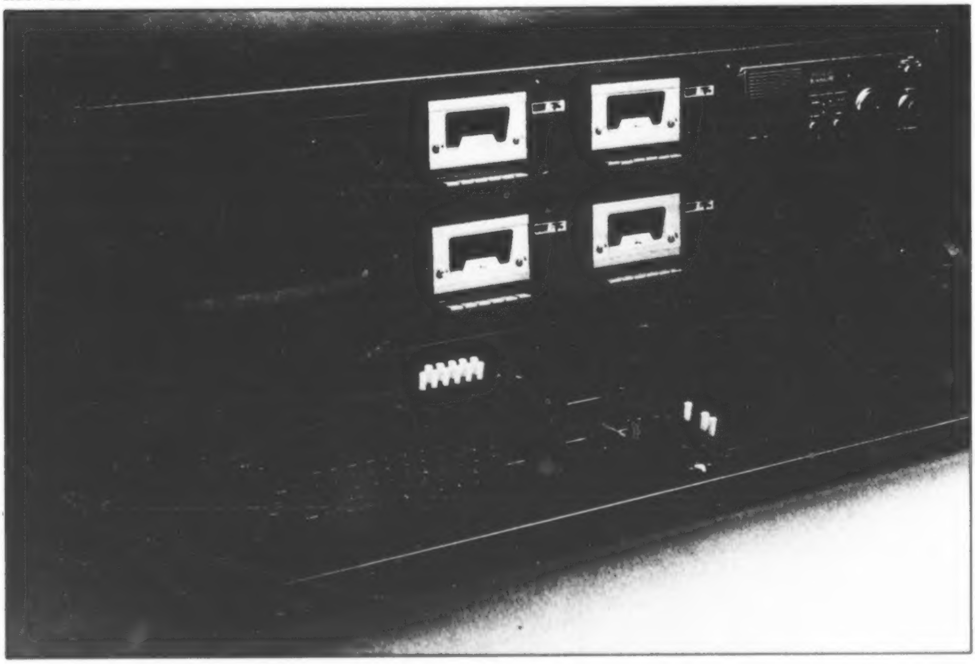
Overcrowding of the radio bands is a world-wide problem. Reversion to the use of Morse code for some communications purposes can help to alleviate matters, as hundreds of continuous wave Morse channels can be accommodated in one speech channel. But the principal advantages of Morse code are simplicity, negligible power requirements for an operating station and the important feature of message reception despite interference.

In its simplest form, radio communication by Morse may utilise the continuous wave (CW) mode of transmission. A single frequency carrier wave is switched on and off for short and long intervals to represent the dots and dashes of the Morse code. At the receiver, a locally generated radio frequency wave is used to beat with the received carrier to enable the operator to monitor the signals at an audio frequency.

Whereas 'commercial speech' occupies a band of frequencies about 3000 Hz wide, hundreds of CW Morse channels can be accommodated in one speech channel.

Another method of Morse transmission by

***Below:** The KB4000 morse training unit, available for Arabic as well as Roman characters, has extended the possibilities of the morse communications network.*



radio is frequency shift keying. When the contacts of the Morse key are closed, they cause the steady frequency, FC of a carrier wave to deviate by a few hundred hertz, to a higher frequency, FS.To monitor the signals at the receiver, the beat frequency oscillator (RFO) is tuned very closely to the carrier frequency, FC. Every time the carrier deviates to FS, the difference in frequency (FS minus FC) will be heard. If the carrier is shifted by 400 Hz, for example, the bandwidth of the transmission will also be 400 Hz.

The large number of radio stations in the HF band is such that overhearing between stations and distortion are common problems. In the event of intermodulation between speech channels, great difficulty can be experienced in obtaining a clear message. If the same problem arises with Morse, however, a good operator will be able to adjust the BFO, avoiding the interference, and take a lucid message.

Morse is ideal for military requirements since secrecy is ensured by sending signals at high speeds. The method is to store the message to be transmitted in a memory and then send it as a short, fast burst. As the transmission lasts only a few seconds, it is difficult for anyone to tune into the station and monitor the message. The recipient, however, can record the signal and read it later at a slower speed.

A Morse link will work even over a badly degraded line or in the presence of extraordinary amounts of interference and fading. When conditions prevent a station from operating in voice mode, contact can often be maintained by switching to Morse.

But the real advantage is the compact size of the operating equipment. On the battlefield, a soldier cannot carry heavy, bulky telecommunications equipment but Morse instruments are easily transportable.

Some ship-to-shore and ship-to-ship communications are still carried out in Morse code. Visual audio-ranging marine and aviation direction-finding beacons emit a slow Morse signal. Many fishing vessels and small ships are only equipped to send and receive Morse, so coastguards and costal stations must be similarly equipped to communicate with their charges.

Many Third World countries use Morse over high frequency radio to maintain links with remote villages, and civil and military aviation authorities often rely upon receiving meteorological data from remote stations by Morse Communication.

This upswing in interest and widespread use of Morse has created a need for more sophisticated equipment. Thus, electromechanical instruments are now being replaced by microprocessor-controlled products including encoders, decoders and code generators.

One objection to the use of Morse is the lengthy and complicated training involved for operators. However, the use of microprocessors and integrated circuits means that a QWERTY keyboard or a standard teleprinter can now be used to compile messages. It is often necessary for operators to be able to send more Morse manually, however. New sophisticated equipment can provide flexible electronic training allowing for varying degrees of proficiency.

A complete training programme can be provided so that every aspect of Morse code communications can be trained and tested. There is a base unit for different and multi-language equipment, including a specifically designed unit for Arabic. Training equipment had previously been restricted to languages using Roman characters so the development of an Arabic console expands the Morse communications network to this increasingly military-significant area.

However, a number of problems were encountered during the development of this equipment in particular, the many different types of Arabic dialect and also the Arabic characters which differ according to where in a word that character is placed. This was overcome by taking '1980 Baghdad' Arabic, which is standard within the telecommunications industry, and assigning a particular Morse configuration to this standard Arabic character set.

Frequently it is not possible, or practical, for operators to spend time learning to transmit Morse manually. However, sophisticated equipment is now available to enable untrained operators to edit and send messages easily. This equipment also has automatic functions enabling a fixed message to be sent simply by pressing one key.

The extension of Morse to many different countries will ensure that it remains an international communications medium. The simple, low power requirements for a Morse operation station, even when messages are being sent over immense distances, compare very favourably with expensive and complicated voice transmission equipment. When conditions prevent a station from operating a voice mode, contact can still be maintained by switching to Morse. Together with the advantages of message reception despite interference, this makes Morse very viable for many years to come. □

TRANSPORTABLE RADIO SYSTEMS: ASSESSING THE ADVANTAGES

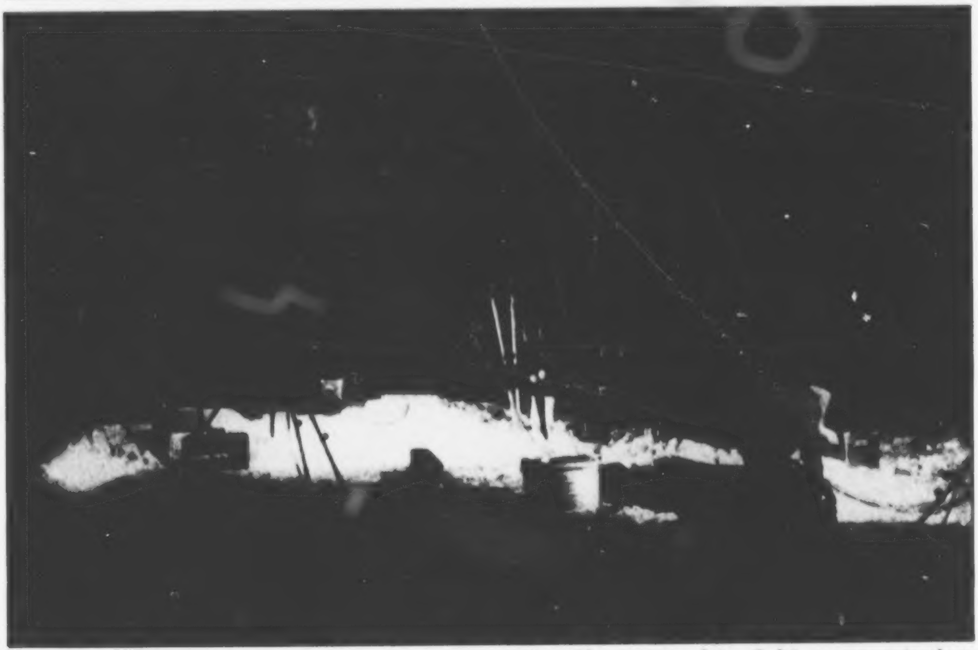
by John MacDonald

Versatility and cost-effectiveness are major priorities for telecommunications systems in Third World countries. John MacDonald, of the International Marketing Group of Loral TerraCom in California, gives a brief summary of how transportable systems, based on communications by line of sight microwave radio, can match these requirements.

***Left:** Portable microwave radio systems are in service with the military for tactical communications. **Above:** PTT organisations use duplex portable microwave radios for two-way analog or digital communications. **Below:** A microwave video surveillance system in permanent service in Saudi Arabia. **Below left:** Emergency restoration of microwave radio communications at a repeater site in Northern Norway.*

THERE is much that has been said in the past about the critical need for improved telecommunications capabilities in the Third World. Their impact on future economic growth and improvements in social care and agriculture is recognised by anyone who fully appreciates the influence of first-rate communications networks on the industrial, economic and military progress of developed countries. The next step is to consider the actual implementation of changes that need to be made.

In general, Third World countries have communications infrastructures that are not only inadequate in capacity and capabilities, but are also comprised of equipment types that vary dramatically in source of manufacture, applications within the systems and, not least of all, age. This unfortunate situation is the result of many contributory factors, some of which are related to financial resources, technical expertise and political attitudes towards the perceived value of improved national communications. It is within this complex environment that the telecommunications planning engineers of today's Third World must find the right balance of resources and results that will allow each country to benefit most rapidly from better communications both nationally and with the rest of the world.



***Above:** Emergency restoration of microwave radio communications at a repeater site in Northern Norway.*

It is therefore clear that planning decisions leading to the earliest improvement of the telecommunications network should attempt to include equipment that is extremely versatile, rapidly deployable and cost-effective. For transmission requirements, in particular, such equipment is available in the form of transportable systems based on communications by line of sight microwave radio. The great value of this concept is that the systems can be designed especially for a particular application, or configured in such a way that they are capable of supporting a wide variety of applications within any communications network. They can be simple, or very complex, but in general they are capable of filling many roles, some of which are described in the following examples.

***Below:** A temporary microwave link maintains service during construction of permanent broadcast facilities.*

Typical applications

Temporary services

As a transmission network is being built up, the need for services will in many cases be rather urgent, but the time required for equipment selection, acquisition and installation can cause severe delays in the provision of services. This can apply to fixed-station microwave links, or buried and pole-mounted cable carrier systems.

While these permanent facilities are under construction, a mobile microwave-based temporary communications system can be moved into place to provide essential services. After the permanent system has been commissioned, the mobile equipment can be relocated elsewhere for the same purpose, and perhaps even reconfigured for a different type of application. The most versatile systems available today can be reconfigured very easily, by simply changing modules, to handle many kinds of traffic, including digital signals, FDM telephony, colour television or even wideband radar.

Propagation studies

These systems can even be used in the planning stages of permanent fixed-station microwave radio links. The engineers that are designing the link can use the transportable systems to assist in the study of propagation effects, and thereby make the best technical and economic decisions regarding frequency selection, protection modes and various other equipment characteristics.

Emergency service restoration

The same mobility and versatility of the temporary systems can also be used to advantage whenever rapid deployment is essential as, for example, during emergency restoration of transmission links that have failed or have suffered damage. In these cases, the microwave radio equipment will be capable of being rapidly returned to different frequencies in order to match that of an existing microwave link that has failed, or simply to avoid interference with other frequencies already in use. Today's state of the art emergency restoration microwave radio systems are not only easily field-returnable within a defined frequency band, but can also be reconfigured very quickly to operate within an entirely different band. This means that the same equipment is an effective and rapidly deployable back-up for virtually any of the frequency bands used by government or private telecommunications agencies, military, tactical or strategic communications, broadcasters or private industry. Private telephone companies and national PTT also use transportable and agile microwave radio systems as an additional source of revenue by leasing the equipment to a variety of users for temporary or restoration applications.

Network flexibility

The telephone companies and PTT also benefit from having available to them, at short notice, a method of providing alternate trunk routing between toll switching centres, or between those switching centres and local exchange offices. There will also be occasions when a trunk route will need a temporary increase in traffic capacity because of special events, such as election coverage, conventions or the visits of heads of state.

A microwave radio-based transportable communications centre can be designed to provide any level of services, by integrating into the system the necessary support equipment. This may include digital or analogue trunk-line multiplexers, voice and data multiplexers for the provision of subscriber services, or combinations of these. A fully equipped system would also include a selection of plug-in modules for the radios to reconfigure the transportable communications centre from trunk and subscriber applications to full-colour broadcast video, or even high-resolution radar for radar remoting at airports or coastal defence installations.

The advantages of transmission by microwave radio

The most important and most obvious advantage of using microwave radio transmission is the ease of establishing a communications link once line of sight has been achieved between the radio terminal at each end. The cost of establishing the link is essentially independent of the nature of the terrain between the terminals, which is certainly not the case for cable carrier systems, especially if the geography includes valleys, rivers, marshes or other natural obstacles. It is especially true in cases such as these that the system is rapidly deployable because the communications link can be made operational much more quickly than is possible with other methods.

Other types of radio systems, in the VHF or UHF range, for example, share the same deployment advantage with microwave radios, but are very limited in capabilities. The microwave frequency bands accommodate not only the light-route capacities of the lower bands, but also a great deal more. There are off-the-shelf portable microwave radio systems available today that will handle up to 2,400 FDM channels on a single RF channel, or up to 45 megabits/second digital traffic, in almost any frequency band between 1.7 GHz and 19.7 GHz. The most advanced of these systems are modular, and are capable of addressing any of these possibilities as the field technician simply chooses the appropriate modules.

In a complex and interdependent world, in which both telecommunications requirements and technology are evolving rapidly, Third World countries must take advantage of any realistic opportunity to develop their telecommunications capabilities as quickly as possible. One of the foundations of a nation's ability to generate wealth and self-reliance is the quality and versatility of its telecommunications network, and the nation's ability to maintain it. For development, maintenance and extension of the network, the transportable multi-purpose microwave radio communications system is an extremely effective tool and one more way for a developing nation to progress with confidence from the present to a share of the future. □

Export program

Band I to III and IV to V TV transmitters, TV studio equipment. Medium wave and long wave radio transmitters, radar stations, dispatching VHF radio networks. Transmitting tubes, power klystrons for TV transmitters, pickup tubes, microwave tubes, gas and ruby lasers. Studio sound equipment, broadcasting studio equipment, consoles, outside broadcasting vans. Multiplex transmission systems (FDM and PCM systems), special measuring instruments for multiplex systems, equipment for load dispatching offices in power systems. Public exchanges and nodal switching centres, exchange equipment, standard and electronic private branch exchanges.

Automatic telephone sets, explosion proof telephone instruments, manager and secretary communication systems, dispatching intercommunication systems, house telephones.

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Foreign Trade Corporation
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170 88 Praha 7
Czechoslovakia
Telephone: 8741111
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ONCE UPON A TIME . . .

. . . 1682. That's when records first mentioned the ropemaking business of the Felten family — a business which marked the real origin of the cable works that followed.

In 1812, Carl Guilleaume — the grandfather of the company's founder Franz Carl Guilleaume — married into the Felten family.

On 14 June 1874, Franz Carl Guilleaume and his cousin Emil opened a factory for cables on a green meadow in Mülheim.

The company developed into a cable manufacturer — specializing in cables for telecommunication and power.

In 1876 came the next milestone in the history of Felten & Guilleaume Carlswerk: this was the first trial route for telecommunication via an underground copper cable.

Paper-insulated telephone wires were introduced around the turn of the century. These were used, almost unchanged, by the Deutsche Bundespost right up to the seventies.

These were followed by submarine telephone cable and, later, the transatlantic cable.

In a few decades, F & G developed from a Cologne factory into a German company of national importance; today the Company faces the future with a well-proven, innovative product range and with its quality-orientated philosophy.

Since January 1, 1982, part of our Group has borne a new name and has widened its scope of operations.

Philips Office and Information Systems, Telecommunication Equipment and Telecommunication Cables and Systems. Each is now a division of Philips Kommunikations Industrie AG, or PKI for short.

Felten Guilleaume Carlswerk AG, a company rich in tradition, was renamed Philips Kommunikations Industrie AG and has its head office in Nuremberg.

At the 1985 Hanover Trade Fair, we presented a new type of mono-mode fibre developed from Philips' research which, in the 1,300-1,550 nm waveband, permits the transmission of several 565 Mbit signals by multi-plexing.

On the optical-fibre links, our 140 Mbit/s systems are currently being used; per fibre, they allow simultaneous transmission of 1,920 telephone conversations or an equivalent quantity of data. The next generation of optical fibre transmission systems operates at rates of 565 Mbit/s (i.e. 7,680 conversations per fibre). These mono-mode fibre systems are being tested on a section that we set up in Berlin. They are to be used for regular service on trunk lines beginning in 1987/88.

Electricity generating companies also had a greater demand for telecommunications facilities in 1985. Self-supporting aerial cables were again a key area, as more and more companies convert their telecommunication networks to optical fibre air cables.

In industry, too, optical fibres are gaining in importance. For example: we are installing at the production plant of a well-known car manufacturer the infrastructure for a local network based on this forward-looking technology.

In 1985, we completed the telecommunication cable project between the Tunisian towns of Gafsa and Gabès; this facility stretches more than 170 km and is used for postal and railway communication services. In Syria, we completed a 270 km-long cable link between Palmyra, Tadmor and the Iraqi border; this turnkey project was set up by us and handed over to the customer.

We also won new orders for highgrade telecommunication cables and jointing products from Zimbabwe; Iran, Lebanon, Malaysia, Chile and other countries.

TELECOMMUNICATIONS

Communication Systems Transmission systems

- ☐ Analogue baseband/FDM systems
- ☐ PCM systems
- ☐ Digital multiplex systems
- ☐ Digital line equipment for electrical or optical transmission
- ☐ Video/sound/data transmission systems
- ☐ Video/sound codecs
- ☐ Video-conference studios
- ☐ CATV systems
- ☐ ISDN local loop transmission systems

Switching systems

- ☐ Digital local or trunk switching systems
- ☐ Packet switching systems
- ☐ ISDN/BB-ISDN switching systems
- ☐ Video/sound switching units
- ☐ Value-added network services equipment
- ☐ Specialized public switching systems

Operations systems

- ☐ Digital line transmission alarm and maintenance systems
- ☐ Digital access and cross-connect systems
- ☐ Control and maintenance systems for public networks
- ☐ Remote control and maintenance systems for CATV networks

Defence and control systems/Radio communication systems

- ☐ Mobile or base stations for mobile telephone systems

Telecommunication Cables and Systems

Cables and turnkey cable projects for telecommunications

- ☐ Symmetrical, coaxial or optical underground and submarine cables
- ☐ Self-supporting aerial cables with optical fibres or symmetrical copper conductors
- ☐ Jointing material and accessories for copper or optical telecommunication cables
- ☐ Planning and installation of cable projects

Radio-frequency cables and systems for video, audio and data transmission with standard or flame-retardant sheath/ Telecommunication measuring equipment

- ☐ Fault-location measuring instruments
- ☐ Measuring equipment for optical communications technology
- ☐ Computerized cable testing systems

Connectors for coaxial or optical fibre cables

Winding wires

- ☐ Round or flat enamelled copper wire
- ☐ Paper, glass-silk or kapton covered copper wire
- ☐ Transposed cables
- ☐ Lead-out wires and strands
- ☐ Bare copper conductors

Office Automation

Office and Informations Systems

Data, voice and text processing systems

- ☐ Personal computers
- ☐ Office micro systems
- ☐ Small business systems
- ☐ Text systems
- ☐ Archiving systems with optical storage disk
- ☐ Software development systems
- ☐ Software for specific lines of business
- ☐ Generic software
- ☐ Switching systems, network nodes, network management and integration systems
- ☐ Modems
- ☐ Message transmission systems
- ☐ ISDN communication systems
- ☐ Small or medium-sized PBXs
- ☐ Key systems, feature phones

Image processing systems

- ☐ Professional laservision
- ☐ Multi-communication system

Office products

- ☐ Answering machines
- ☐ Dictation equipment

Organizational aids and accessories/ Peripheral equipment

- ☐ Matrix or electrophotographic printers
- ☐ Keyboards for professional use

Philips Kommunikations Industrie AG
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☐

Philips Communication Cables and Systems

For a very long time, Philips has been developing and producing fibre-optic technology and is now without doubt a world-leader.
Philips has set new standards in gradient index fibre manufactured by the PCVD process. This fibre now transmits extremely high bandwidths of the order 3000 MHz · km.
Using the same process, Philips now produces monomode fibre having practically no bandwidth limitations.

Philips produces, delivers and installs fibre-optic technology, both at home and abroad, for all hierarchical levels of telecommunications networks. Both public and private.
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For us it's only natural that this technology of the future is our virtuoso: A virtuoso playing for the benefit of our customers.
You want to shed more light on fibre-optic technology? Then please call us for more information. Who knows, perhaps our call will see the light and be on an optical-fibre!

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PHILIPS

PHILIPS

Developing telecommunications for developing countries

TELECOM AUSTRALIA (INTERNATIONAL) LTD

Some countries have a lot more developing to do than others. And many of these, especially in the Asia/Pacific region, are finding that the strengths of Telecom Australia closely parallel their present needs and future aspirations.
Developing countries need the latest in technology if they are to slow the leap-frogging effects of obsolescence. Yet they also need technology tailored to perform with the utmost reliability in often primitive conditions, and without the benefit of sophisticated support systems.
Because of its background, Telecom Australia is virtually unique in being able to satisfy the needs of developing countries with systems initially developed and proven under some of the world's harshest operating conditions. These systems range from the most basic to the more complex uses of today's technology.
Like many 'developing' countries, Australia is renowned for its difficult terrain, extremes of climate and isolation from the traditional developed centres of the northern hemisphere. Yet working within these constraints, Telecom Australia has become adept at planning and providing world-class telecommunications solutions. Its very isolation has been instrumental in placing it at the forefront of international telecommunications planning.
And it has a strong representation on such organisations as the CCITT (International Consultative Committee on Telephone and Telegraph), CCIR (International Consultative Committee of Radio Communications), and ITU (International Telecommunications Union – a United Nations special agency).
Telecom Australia has been active in recent years in supplying a wide range of services to customer countries around the Pacific rim, Asia and the Middle East. These services include the following:

Strategic planning.
Assistance in developing procedures, including commercially-based organisational structures and customer interfaces.

Network planning.
Help in designing smooth, cost-effective transitions to new technology, new services and higher levels of user demand.

Financial management.
Developing and implementing everything from billing systems to tariff strategies.

Engineering excellence.
Providing expertise in all engineering areas including tenders, orders and equipment acceptance.

Operations management.
Consultancy skills bringing together all administrative aspects, aided by software support systems.

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Consulting services designed to create successful marketing, sales and customer service divisions.

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Advice on the planning and implementation of computer-based systems for all aspects of administration and operation.

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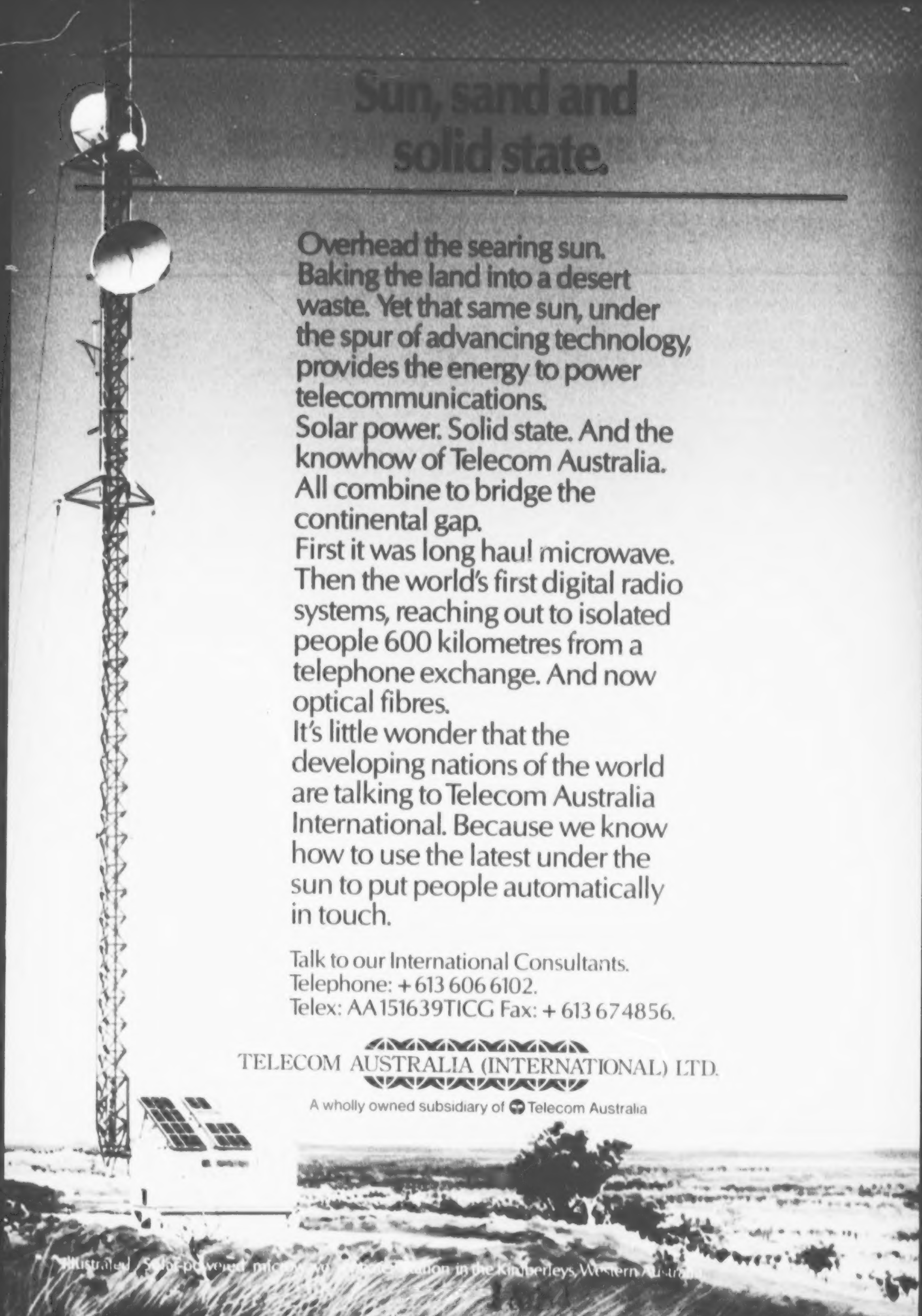

Sun, sand and solid state.

Overhead the searing sun. Baking the land into a desert waste. Yet that same sun, under the spur of advancing technology, provides the energy to power telecommunications.

Solar power. Solid state. And the knowhow of Telecom Australia. All combine to bridge the continental gap.

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Illustrated: Solar-powered microwave repeater station in the Kimberleys, Western Australia.

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Use digital technology to advance networks from electromechanical service toward ISDN, without buying new SPC or digital switching systems.

Bridging To The Digital World
The appeal of digital switching is strong, based on the flexibility, reliability and economy offered by the advance of integrated circuit technology into telephone systems. Manufacturers of digital switches have put a great deal of effort into designing powerful computer-driven systems for public telephone networks. It is comforting to note that the operators of networks with electromechanical and analog electronic exchanges can benefit from the same technology—now able to add feature and economy to their systems without the heavy capital investment required to go fully digital. Teltone offers some cost-effective digital ways to bridge analog switching to the digital networks of the future:

☐**Dial Refinements**
Teltone's well-known dial conversion products (like our M-160 series, M-190, M-321 and M-911) offer telecom administrations the ability to provide subscribers with a number of dial access improvements like:

- DTMF (Pushbutton MF) dialing on electromechanical exchanges
- Call rerouting through dial number translation (DTMF or pulse—administration-programmable)
- Coin-free emergency calling from public telephones on many exchanges
- Called number restriction

Compatible with most Strowger, crossbar and SPC exchanges, Teltone dial converters offer the speed, economy and features needed for PTTs and other service providers to keep pace with overall network improvement plans and customer demands.

☐**Digital Call Recording**
Many years of experience with Strowger and crossbar switching have enabled Teltone to develop a highly cost-effective system to provide call-detail recording for subscribers on electromechanical exchanges. Using distributed computing techniques, Teltone's CallData System (CDS) collects subscriber calling information from the exchange, stores and processes it, and generates magnetic tape records of each subscriber's activity for billing purposes. Using these distributed data processing methods, centrally located minicomputers can gather all records from a number of exchanges scattered over wide geographic regions.

☐**Data and Voice Access for Subscribers**
The growth of advanced data communications is one of the strongest trends in subscriber service. Teltone's Data Carrier System (DCS) is an effective way to add synchronous or asynchronous full duplex data service, at up to 19.2 kb/s—without new cables or wiring. Using existing telephone wiring, Teltone DCS multiplex units offer high-performance data communications over voice service *without disrupting* normal telephone operation. Whether in PABX or main exchange applications, our many DCS offerings permit tailoring data speed, mode and testing ability to each voice and data user.

☐**Quality Control in Switching**
The M-260 Call Disposition Analyzer allows telecom administration to monitor the service provided subscribers, either through automatic call scanning or remote observation using human operators. Handling of calls, incoming or outgoing, line or trunk, can be evaluated by statistical data on call disposition or by commentary from operators skilled in identifying other aspects of service quality. Remote units in any exchange can be accessed from single or multiple control centers, protected by dialback with security codes. Subscriber service quality assurance can then be coordinated from a single location.

☐**Components**
Teltone's skill in the use of integrated circuit technology to reduce the size and cost of complex circuitry has produced a demand for its microcircuits outside the company. Long a leader in multifrequency tone detection techniques, Teltone has provided many hundreds of thousands of DTMF (Pushbutton Multifrequency) and other tone detector devices to the telecommunications industry for use in switching and subscriber equipment. From DC and voiceband signalling, to high-speed data multiplexing, Teltone has components that can enhance the designs of manufacturers worldwide.

Look to Teltone Corporation for advanced technology, in support of practical telecommunications.

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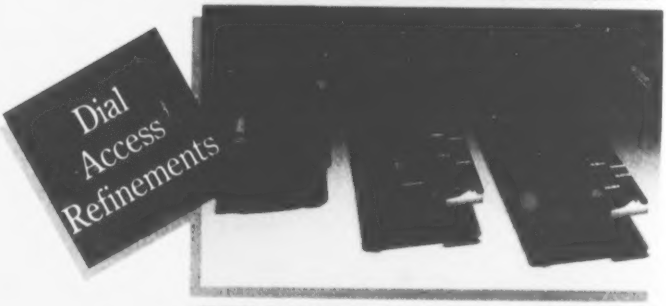

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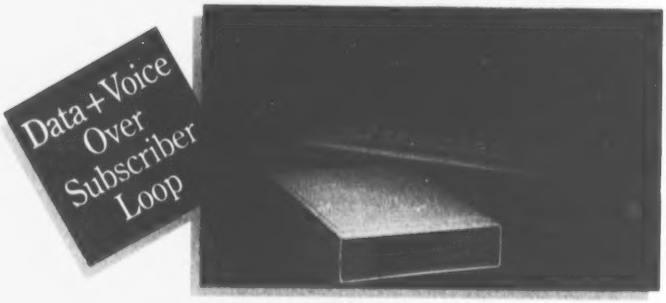

Data+Voice
Over
Subscriber
Loop

Contact us for the name of the Teltone representative in your area.

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Where telecommunications
Reliance Comm/Tec delivers

The concept of ISDN—an Integrated Services Digital Network—is the foundation for a global system that eventually will interconnect the world. Someday.

But PTT managers of developing nations work in real time. They are faced with skyrocketing customer bases and need reliable and cost-effective approaches to providing basic telecommunications service. Now.

From the Arctic Circle to Argentina, the source for fundamental products for the local loop—connection, protection, power, and transmission enhancement devices—is Reliance Comm/Tec. Through three names in the industry you have known for decades—Lorain Products, Reliable Electric/Utility Products, and R-TEC Systems—Reliance Comm/Tec delivers an unprecedented number of products and services anywhere people communicate over copper cables. With representation on every continent except Antarctica, Reliance Comm/Tec products are installed in more than 50 countries worldwide.

A premier U.S. telecom enterprise, Reliance Comm/Tec ranks second only to AT&T in the production of outside plant and power conversion equipment. Overall, the company is among the top 10 largest U.S. manufacturers of telecom products with sales for 1987 projected to be U.S. $350 million.

eeds are the greatest, solutions that work—today

Here's a brief overview of this diverse organization that employs more than 3,500 people in eight states, Canada and Mexico, and participates in a joint venture in Japan.

Power Equipment:
With a retinue of more than 800 standard power conversion products in its catalog, Lorain Products can fulfill just about any order from inverters to converters to uninterruptible power systems. With solid experience in the industry dating back to 1936, nobody knows more about this critical technology. And as an innovator, Lorain is consistently in front with developments such as its microprocessor-controlled power system monitors and controllers as well as new applications of high frequency technology to make possible more compact and efficient chargers and rectifiers.

In a recent 18-month project in Chile, Lorain engineers and equipment played a key role in rehabilitating 38 step-by-step central offices around the country. These eminently serviceable switches, operated by Cia. de Telefonos de Chile, were updated with new 48-volt power systems, including power boards and ringing plants.

C.O. and Outside Plant:
Through its predecessor companies since 1909, Reliable Electric/Utility Products has been a leading supplier of central office connectors, protectors and termination devices. The overriding goal of the company's design team is to deliver main distribution systems that pack in more terminations per square foot than anyone else.

In the local loop, Reliable's cross-connecting terminals are built to withstand the ravages of any environment. From simple two-pair station protectors to giant 3600-pair BT Strongboxes, Reliable has the product to fit any cable distribution application.

Reliable's outside plant expertise was put to the test in Egypt when the company supplied cross-connect and wall/pole mount terminals for a massive U.S. A.I.D. program to upgrade and bury cable facilities in Cairo and its environs. Directed by the Egyptian telephone authority, ARENTO, the newly completed project has spanned three years.

Transmission Enhancement:
Very often, the telephone networks of developing nations are plagued by insufficient facilities to serve customer demands and poor transmission quality. R-TEC Systems has time-tested solutions to both of these problems.

With pair-gain patents dating back to 1964, R-TEC Systems was an originator of subscriber carrier technology and offers both analog and digital products. Subscriber carrier enables PTTs to electronically increase the call-carrying capacity of existing cable to serve new customers immediately where facilities are exhausted.

R-TEC also offers a complete line of voice frequency products including repeaters, loop extenders, and amplifiers as well as remote subscriber loop testing equipment.

Here is a dramatic example of how R-TEC's CM-8 Subscriber Carrier helped the Irish PTT, now Telecom Eireann, get service to thousands of customers in the midst of a major program to replace central offices with digital switching. At the end of 1980, there were 92,000 held orders in Ireland and no immediate relief in sight. After being introduced to CM-8, however, the PTT was able to serve customers quickly in the most troubled areas, and then move and reuse equipment following new C.O. cutovers.

After installing some 42,000 channels of subscriber carrier, held orders were reduced to less than 20,000 by the end of 1986; the number was expected to decline to normal demand levels by the end of 1987. At the peak of installations in 1983, about 12 percent of all customers were served by subscriber carrier.

Would You Like to Know More?
For more information about the products and services of Reliance Comm/Tec and to receive a copy of our 1987 Minicatalog, contact our headquarters office in Chicago.

Group Headquarters
8600 W. Bryn Mawr
North Tower, Suite 950
Chicago, IL 60631 U.S.A.

312-693-0400
Telex: 270374
Fax: 312-693-7618

RELIANCE COMM/TEC

Look to the leader for your analog equipment needs.

Western Multiplex Corporation offers the most comprehensive selection of high-quality standard and custom analog products available for FDM multiplex and microwave radio baseband management.

Just look at the types of standard items offered:

Amplifiers
Converters
Attenuators
Baseband Switches
De-Emphasis Networks
Equalizers
Frequency Generators
Frequency Translators
Hybrids
Loop Protection Switches
Pilot Equipment
Pre-Emphasis Networks
Filters
Bridges
Wideband Translators
Pads
Wire Line Equipment
Active Bridges
Combiners
Group Converters
Transformers
Splitters

The Western product list seems endless. That is because if we do not have the product you need, we probably can build it for you.

For expert assistance and rapid response to your individual requirements, contact Western Multiplex:

1320 Bayport Ave.,
San Carlos, California
94070 USA
Telephone (415) 592-8832
Fax (415) 595-2280
Telex (via RCA)
295114 WESMUX

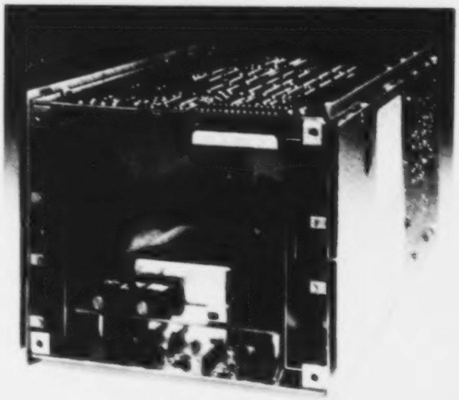
WESTERN®
MULTIPLEX
CORPORATION

ANALOG PRODUCTS FOR MICROWAVE RADIO BASEBAND MANAGEMENT

Over the last several years there has been a large increase in the number of communication paths where digital transmission is economically feasible. This has required greater production quantities from suppliers of this equipment and, as a result of this large increase in demand for their digital products, many major manufacturers have cut back or discontinued their low production volume analog products. Having recognized several years ago that the demand for analog equipment would not cease altogether (certainly not for some time), Western Multiplex Corporation has developed a full line of analog microwave baseband equipment including bridges, filters, amplifiers, attenuators, hybrids, transformers and group, supergroup and wideband translators. Western Multiplex also supplies fully wired and tested system assemblies and will undertake equipment modifications or new designs to a customer's specific requirements.

All members of the Western Multiplex family of products are of recent design and use the latest technology applicable to each one. Whilst some items may replace products from other manufacturers in function (and occasionally also in form), the designs are all proprietary to the company. The innovative design of Western Multiplex products does not only apply to the electronic circuitry, the mechanics of the products are also engineered to suit the application (see photograph). All products are designed and built to the highest international standards and offer the user conservatively rated performance coupled with ease of installation and operation, usually with no required maintenance.

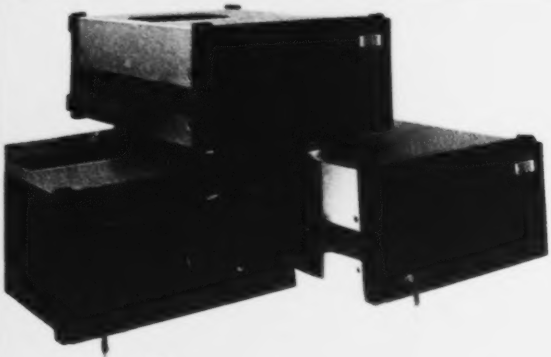
The Western Multiplex commitment to excellence starts with the product design, at which time sufficient margins are engineered in to ensure easy production and reliable operation. Great care is also taken in selecting both the component types and their suppliers from around the world. During manufacture, each stage of assembly is performed by personnel who are also responsible for inspecting each unit as it progresses. Upon completion, all products are individually tested to ensure that they meet their published parameters. If they are then assembled into a system, it will be tested to the customer's specifications. By paying careful attention to all phases of the production process, especially design, Western Multiplex is confident in offering a three year warranty on all of its products.

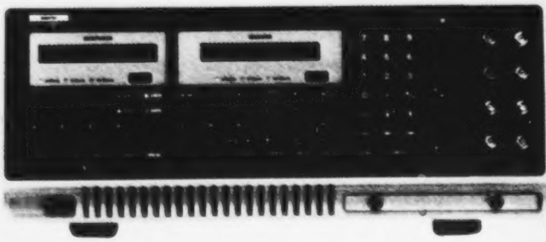


Direct-to-Line Group Modem (faceplate removed)

Find out how Western Multiplex products can help you solve your analog microwave baseband equipment needs, write Western Multiplex Corporation, 1320 Bayport Ave., San Carlos, California 94070 USA. Telephone (415) 592-8832, Telex 295114 WESMUX (Via RCA).

Enertec Instruments





A new generation...
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- **Optical fiber measuring instruments, 7720 series**
  For laboratory and field use
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  0.85μm and 1.3μm multimode
  1.3μm and 1.55μm single-mode
- **Digital transmission analysers, 7700 series**
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  Error, jitter and frequency margin measurements in one unit
  Error performance conforming to the CCITT Rec. G. 821
  Printing or recording of selected results
  fully IEEE488/IEC625 programmable
- **Radio test and surveillance, 4040 series**
  These compact instruments have been designed to meet all HF, VHF and UHF testing requirements from microphone input to antenna output and from antenna input to loudspeaker output.

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Tél. 77.25.22.64 - Télex 300796

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THE Communication Systems Company

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HF SSB/ISB TRANSCEIVER

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- 200-535 KHz
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- Dual Configurations

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25/50 WATT TRANSMITTER

RECEIVER

- Synthesized
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HF SSB/ISB Transceivers...

PARA-MILITARY MANPACK

- 25 Watt, HF Synthesized
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- Waterproof To 1 Meter
- Internal Antenna Coupler

- 150 Watts/1 KW, Continuous Duty
- 16-30.0 MHz, Synthesized Channelized
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- Remote Control

Complete Systems Design...

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- SOLAS Consoles
- Vehicular
- Data over Radio
- PACKET/RTTY/ARQ/FEC

SRS Scientific Radio Systems Inc.
367 ORCHARD ST. ■ ROCHESTER, N.Y., U.S.A., 14606
CABLE SIRAD ■ TELEX 978-368 ■ PHONE (716) 235-2040 ■ FAX (716) 235-7827

SCHRACK

A success story

SCHRACK ELEKTRONIK AG is one of Austria's leading privately-held enterprises in the high-technology field. Besides developing, production and marketing quality products worldwide, we also specialize in problem-solving. Supporting these fields of operation, we offer our well-known reliable service.

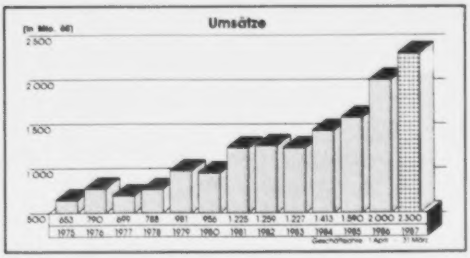
Our areas of activity encompass:
- ■ communications technology
- ■ mass-produced components
- ■ OEM power supplies
- ■ systems engineering

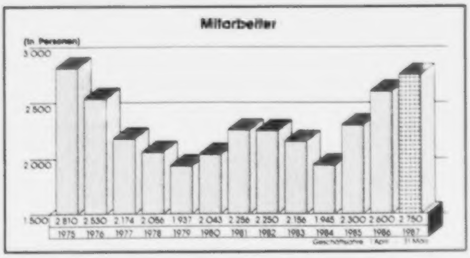
Since 1919 we have been successful in realizing our philosophy of continuous growth. This philosophy necessitates the combination of the best employees with the constant introduction of new technologies, in order to achieve ever-higher standards of quality for our products. Our growth has been steady and carefully planned. Our success proves that we were right to place our trust in a team of experienced managers who developed strategies in co-operation with our employees. Due to our success we have maintained our independence, a good basis on which to grow in the future.

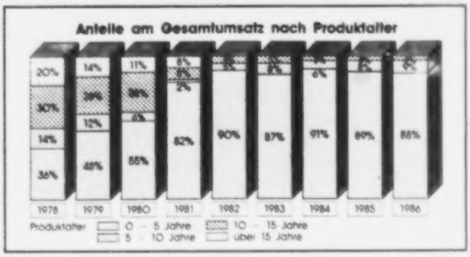
The headquarters of SCHRACK ELEKTRONIK AG are in Vienna. Additional production plants are located in Waidhofen an der Thaya and in Kindberg. Operated as joint-ventures, we have overseas production plants in Saõ Paulo and Mexico City.

Our wide-spride net of sales and service points guarantees every customer maximum attention.

We manage our enterprise so that not only our customers but also the general public benefit from our work. This is a duty which we have always looked upon very seriously. The continuous growth of our enterprise through development, licensing and joint ventures is assured. Still, we plan to improve our position in the present market through progressive technology and professional know-how in production and quality control. Responding to the special concerns and problems of our customers is another area which we emphasize.







Telecommunication program:

- ■ telephone sets in different versions
- ■ analogue and digital PABXs
- ■ special equipment for the PTT (e. g. concentrators)
- ■ data transmission
- ■ electric fire alarm control systems

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SCHRACK

Your partner in digital communications technology

○ public digital telephone exchange system OES-D
○ digital PABX system MULTIDAT
○ data networks

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Motronic

MOTRONIC was founded in 1969, within less than 10 years, Motronic has become an internationally recognized company. Motronic electronics are today a symbol of better communication in both professional and private lives.

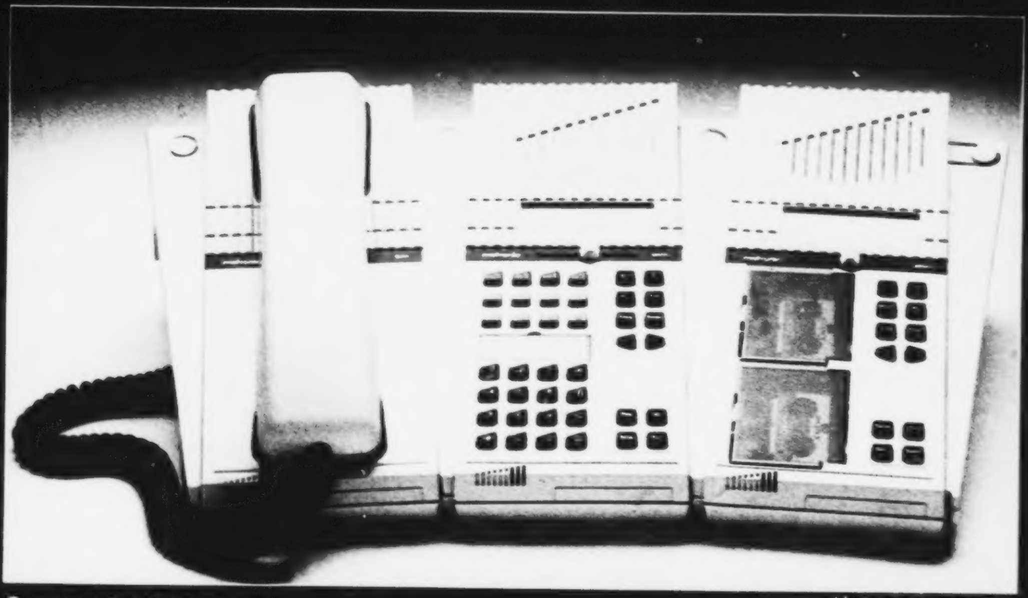
The company head office, together with the production, research and development departments, is located in the delightful landscape of Western Styria, about thirty minutes by car from Graz. The peaceful countryside with its healthy dust-free air, is absolutely ideal for developers and manufacturers of electronics. Despite the "Country Life", contact with the wide world outside is maintained at all times, and there are daily international flight connections to and from Frankfurt, Vienna and Zurich from Graz, the nearby capital of the province, which provides direct contact with international markets.

Good co-operation with the technical university of Graz over many years enables the company to achieve rapid and effective results with innovation and development. The first step towards world-wide recognition was the production of the "pieps", a device for locating avalanche victims. Three years after the company was founded, Motronic presented the world's first automatic dialling telephone system. For that invention, Motronic was awarded the gold medal at the International Inventor's Fair in 1974.

The latest product of the cooperation with the technical university is the multipurpose universal programmable intelligent videotext decoder, the so-called "Mupid", Mupid was first presented in 1982, and international marketing was taken over by a company specially set up for this purpose. In 1983, as a result of many years experience in the field of telecommunication Motronic has succeeded in well designed combining of the telephone, the automatic dialler and electronical number-storage – the Motronic exclusive telephone. For this design Motronic was given an award by the Austrian ministries. As a logical further development to the "Motronic-exclusive telephone" Motronic introduced in 1987 a module-telephone-system which combines key-pad-dialling telephone, alphanumeric dialler and answering machine in one functional block. This "Module-telephone-system" can be configurated according to customer's request.

Another important product-branch of Motronic are the fully electronic Casino-gaming-machines "Casino juwel" and "Casino lotto", which earn worldwide recognition and are already in practical operation in many highly reputed European casinos. Innovation and trend-setting new product development form the basis of this young and dynamic Motronic team, proving that a small customer-oriented company is capable of contributing in a positive way to Austria's economy and gaining world-wide recognition. □

Technology of the future. Today.



Multi-telephone system

Communication systems
for every purpose.

Exclusive executive telephons, multi-telephone-system, coin-operated telephons, personal computer, answering machines, intercoms, car phones, walkie-talkies, radio plants, radio systems, rescue radio signaller, microprocessor controlled Casino gambling machines.
Electronic quality workmanship. Surface mounted technology. The new method which uses both sides of a printed circuit board.
Reliability and quality.
MOTRONIC-specialist for producing electronic moduls of every kind.

Coin lotto machine

Coin roulette machine

Surface mounted technology

MOTRONIC
Elektronische Geräte Ges.m.b.H.
A-8522 Groß St. Florian, Austria
Tel. (0 34 64) 81 81-0
Telex 34490

THE CSX-1024 MASTERING THE SCIENCE OF MAKING ALL TEXT COMMUNICATION SERVICES COMPATIBLE

Design

The CSX System utilizes a distributed processing architecture that contains a microprocessor on each line interface card to handle each specific communications function. This results in available computing power of up to 260 microcomputers, without which protocol conversion and interworking would not be possible. Each line interface card is programmed to handle from one to four circuits. All line interface cards and their associated microprocessors are controlled by redundant 16-bit common control processors. These common control processors control the overall management and flow of data through the system. In addition, the system can be integrated with high volume data storage devices for billing, recording of calls and related statistics.

Network Integrator

For those who have various types of data networks in service (regardless of data speeds or protocols), the CSX-1024 provides the capability of making all user terminals or teleprinters in the network fully compatible. Therefore, the CSX-1024, as a network integrator, extends the life of existing equipment and permits the gradual introduction of new telematic services on an economical basis.

Modularity

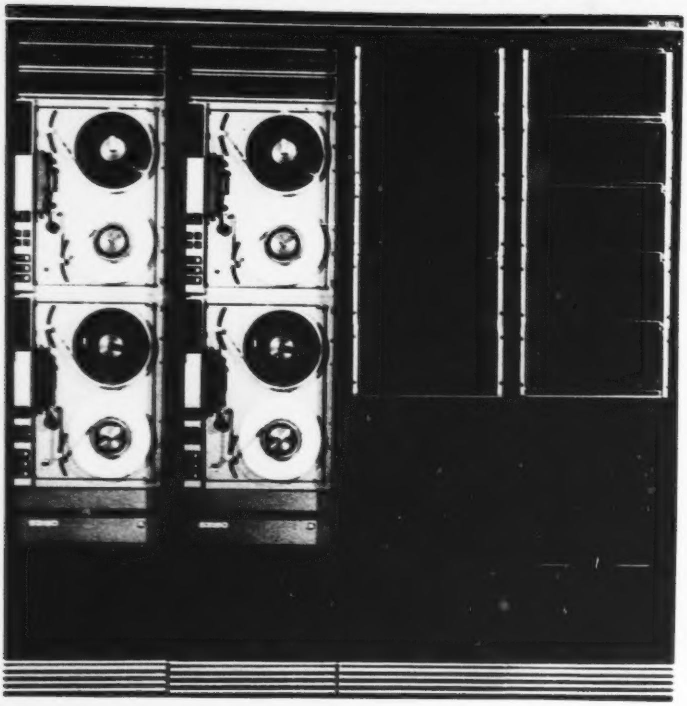
Because of the hardware architecture, modular applications software, and high throughput capacity, CSX-1024 systems can be purchased in configurations with as few as 16 circuits, and expanded to handle as many as 2048 circuits.

Expansion is accomplished by simply adding new circuit interface modules (terminations) with the applicable programs and protocols resident on the termination. As a result, when new circuits or data services are introduced, the protocol are programmed into the termination and only data-base changes are required at the common control level with no loss of service. The data base changes include the physical and operational characteristics of new terminations that are added.

INTELLIGENT BUSINESS COMMUNICATIONS CORP.

ibc corp.

80 OSER AVE., HAUPPAGE, NY 11788
(516) 434-1000 TELEX 968519



Features/Capabilities

- Redundant Common Control
- Synchronous/Asynchronous Capability
- Real time speed, code, and format conversion between incompatible users
- Data rates from 50 baud to 64 Kbps
- Compliant with all applicable CCITT Recommendations
- Redundant Magnetic Tape Call Logging
- Supports virtually all standard data protocols
- Integral diagnostics with fault detection and reporting
- Remote diagnostics and data-base management capability
- Each circuit interface card is microprocessor controlled.

IBC Corporation specializes in the design, manufacture, sale and support of high-performance data communication equipment. The CSX-1024 in conjunction with the available library of software programs are used to provide user defined communication solutions.

Each CSX is designed to perform, on a customized or standard basis, these major functions:

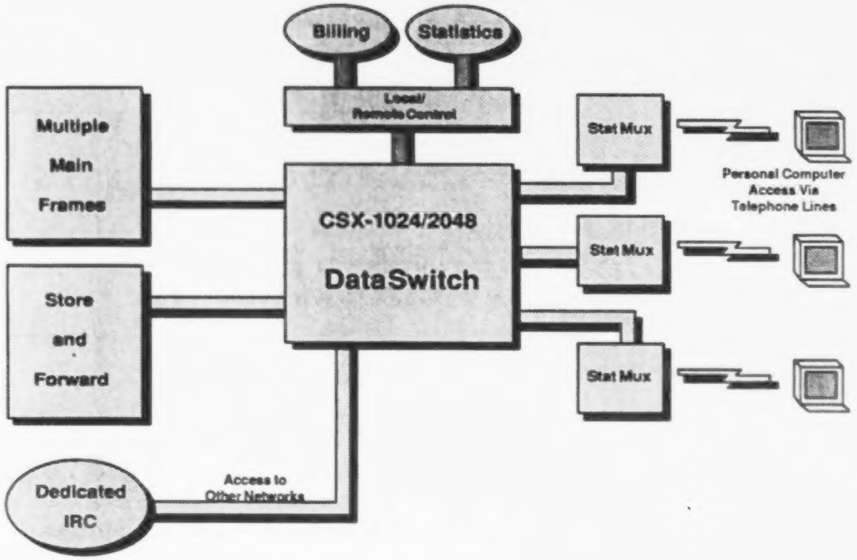
- Protocol/speed conversion
- Routing
- Access control
- Network management
- Billing

Whatever your data handling problem, look to IBC for the answer. The CSX-1024 has proven itself time and again in a variety of data switching applications worldwide. We have enclosed for your review, some application drawings which typify several on-line CSX systems. After reviewing them you may be surprised to find that your solution already exists.

ibc corp.

INTELLIGENT BUSINESS
COMMUNICATIONS CORP.
LONG ISLAND, N.Y.

Access Via Telephone Lines to Multiple Main Frames and Services


Billing
Statistics
Local/
Remote Control
Multiple
Main
Frames
CSX-1024/2048
DataSwitch
Store
and
Forward
Stat Mux
Personal Computer
Access Via
Telephone Lines
Stat Mux
Stat Mux
Dedicated
IRC
Access to
Other Networks

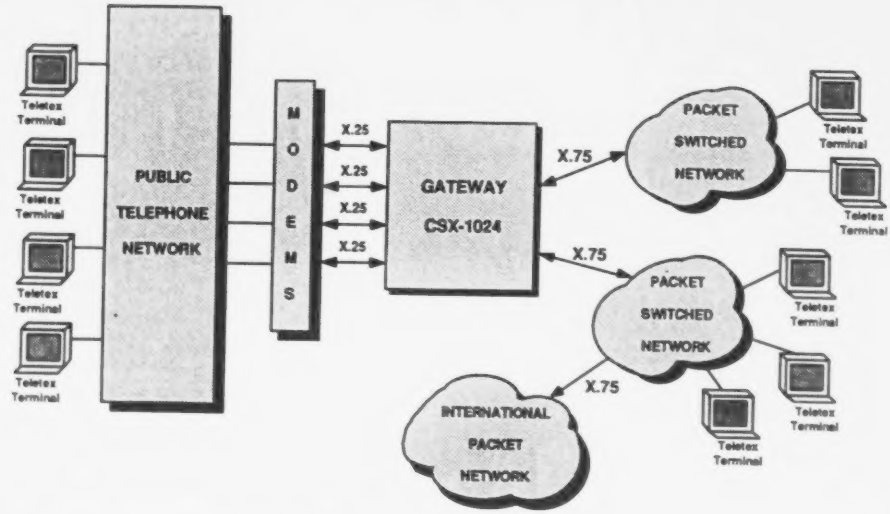
Features Supported

- Speed and Code Conversion
- 300 to 9600 Baud Lines
- Inbound Store and Forward
- Password Validation
- Alternate Routing
- Call Barring
- Area Code Tables
- 18 Discreet Asynchronous Protcols
- Telex to ASCII
- ASCII to Telex
- Single Line Accounting
- Trunk Groups
- Call Forwarding
- Camp On

The CSX performs the function of an intelligent router. It connects various subscribers to multiple host computers and netwroks in the most efficient manner. The CSX database provides **password validation** for access control and the **network management** feature accommodates single line **accounting**, operational **statistics**, and database modification.

ibc corp.
INTELLIGENT BUSINESS
COMMUNICATIONS CORP.
LONG ISLAND, N.Y.

Telephone Access to Multiple Data Networks


Teletex Terminal
Teletex Terminal
Teletex Terminal
Teletex Terminal
PUBLIC TELEPHONE NETWORK
MODEMS
X.25
X.25
X.25
X.25
GATEWAY CSX-1024
X.75
X.75
PACKET SWITCHED NETWORK
Teletex Terminal
Teletex Terminal
PACKET SWITCHED NETWORK
Teletex Terminal
Teletex Terminal
Teletex Terminal
X.75
INTERNATIONAL PACKET NETWORK

Features Supported

- Security Access
- Dial In/Dial Out
- X.25 to X.75 Interworking
- X.75 to X.75 Interworking

Gateway

The CSX configured as a gateway, allows data line subscribers on the Public Switched Telephone Network (PSTN) to exchange data with subscribers of both national and international Packet Switched Networks. Protocol and speed conversion, which are required to interconnect **X.25**, **X.75**, **PSTN** and **teletex** equipment, are performed by the CSX. **Routing** is accomplished through an addressing scheme which accommodates both network and subscriber addresses. **Password and address validation** provides adequate access control to the gateway, and the network management feature permits database reconfiguration, as well as customer billing information.

ibc corp.
INTELLIGENT BUSINESS
COMMUNICATIONS CORP.
LONG ISLAND, N.Y.

GN Elmi
– Professionalism The Nordic Way

Established in 1971, GN Elmi is a subsidiary of the GN Great Nordic, a group that now comprises 42 companies in 15 countries. The group covers a broad range of products within communications, informatics and electronics.

Our product range is high quality electronic measuring instruments for telecommunications – developed and manufactured on own premises.

GN Elmi instruments are the result of our high degree of innovation and technical knowledge combined with the impact of a close cooperation with end users from the teleadministrations. This combination has proven successful, and GN Elmi is now recognized as a leading supplier of

- PCM test and maintenance equipment
- MFC signalling test equipment
- Subscriber control and billing systems

The GN Elmi idea of "Professionalism The Nordic Way" can be read in our service concept: Supreme professional standard on all levels combined with capacity and flexibility to meet our clients' needs on a world-wide scale. In addition our product design is highly influenced by our Nordic back-ground.

For you it means instruments with simple and logical build-up – designed for use. The service concept and design are reflected by our unusual company structure.

At present the PCM product group consists of five instruments.

PCM Signal Monitor EPM 11
An in-service measuring instrument for surveillance and fault-finding on digital transmission lines (2 Mbit/s).

PCM Signal Generator EPG 21
An out-of-service instrument generating digital speech patterns. Primarily for installation use.

PCM Signalling Recorder EPR 31
An instrument for fault-finding on the communication links between two exchanges. The instrument is the only one on the market.

Higher Order Signal Monitor EPM 41
An in-service instrument for higher order transmission (up to 140 Mbit/s). Like the EPR 31 the instrument is the only one on the market.

PCM Error Analyser EPE 51
An instrument for detailed fault analysis and surveillance on digital communication links.

The MFC signalling product group consists of:
MFC Display
Can be connected to the registers, code transmitters and receivers or to the trunk lines, depending upon the point at which the MFC signalling is to be monitored
Multi Frequency Test Equipment
Performs test on multifrequency, sending and receiving equipment with an automatic preprogrammed test mode for the most commonly used signalling systems.
Subscriber, control and billing product group consists of instruments which record subscriber call data in telephone exchanges. Features are detailed billing, toll ticketing, check of charging system, call verification and collecting of statistical information. Three instruments are available.
ZTTK 40202 for connection of one subscriber.
ZTTK 40404 for connection of up to 16 subscribers.
SMART ECF 10 for connection of up to 540 subscribers.
To keep the high degree of innovation and technical knowledge, almost one third of the staff is engaged in development of new products.
Since its foundation, GN Elmi has continually been expanding, product-wise as well as geographically, and now exports 95% of its output to telephone companies and manufacturers of telephone equipment through agents and distributors in more than 50 countries.

Telecom Test and Maintenance Equipment

We are Always Looking for Trouble

Time is flying, but interexchange signalling troubles remain:

- Is the old reliable exchange not so reliable after all?
- Is the new exchange suffering from teething troubles?
- Are all exchanges talking the same language?
- Who or what is to blame?

These troubles and many others can be solved by GN Elmi's highly developed range of telecom test equipment.

For years GN Elmi has specialized in monitoring and analysis equipment for interexchange signalling. We offer you troublefree troubleshooting for the past, the present and the future:

- Analog tone signalling
- MFC R2 in analog systems
- MFC R2 in digital systems
- CAS
- CCS system 7
- ISDN

Ask for further information and profit by the Great Nordic experience in troublefree troubleshooting.

GN Elmi

90, Kirkebjerg Allé.
DK-2605 Brøndby. Denmark
Phone + 45 2 45 42 11
Telex: 33423 elmi dk.
Cables: Elmiworks
Telefax: + 45 2 63 18 41
(CCITT gr 2 + 3)

Memotec
Toward a World-Class Telecommunications Company

Memotec Data Inc. is an international network provider and systems integration company with headquarters in Montreal, Canada.

Memotec currently has four business units: the Data Communications Division, Montreal; the Real Time Division, Toronto; a U.S. subsidiary, Infinet, Inc., North Andover, Massachusetts; and Teleglobe Canada Inc., Memotec's subsidiary as of April 4, 1987.

Data Communications Division
The Data Communications Division, operating from the company's head office location, builds sophisticated communications processors for customers requiring high-performance data networks. These networks typically link computers, terminals, personal computers, word processors and other devices, from many different vendors, for instantaneous local, national or international X.25 communications.

The customers of the Data Communications Division include banks, insurance companies, airlines, hospitals, governments, transportation, manufacturing, retailing businesses, energy, brokerage firms and public telephone companies.

Early in 1987 the division announced a major three-year research and development program.

The products developed in this program will enable the Data Communications Division to penetrate new market segments including Integrated Services Digital Networks (ISDN), direct links to large communications nodes and gateways for the office market and retail business.

Infinet, Inc.
Infinet, Inc., designs, manufactures and markets a complete family of systems that integrate into data communications networks and perform essential monitoring, control, management and restoral functions.

Infinet products and services provide for fault-tolerant operation of complex, geographically dispersed data networks, and thus are particularly significant for large networks where reliability is critical. Its customers are typically in industries such as banking, securities brokerage, air transport and lodging, where delivery of time-sensitive information is vital. Infinet's products and its U.S. sales and service network are complementary to those of the Data Communications Division.

Infinet systems, which integrate into the network, are designed to minimize downtime by providing network managers with a set of tools to collect and analyse performance information, identify faulty elements and, in some cases, quickly restore them.

Real Time Division
The Real Time Division is a systems integration provider, engaged in the design and marketing of information processing systems and services for the general insurance industry and municipal governments.

Real Time, formerly Real Time Datapro Ltd., has been managing insurance information since its predecessor was established in 1911. Real Time was acquired by Memotec in August 1985.

Teleglobe Canada Inc.
Teleglobe Canada, a federal Crown corporation until its acquisition by Memotec, is the country's overseas telecommunications carrier. By linking Canada to the world outside North America, Teleglobe gives the international dimension to not only the familiar telecommunications services, but also the newer and fast-growing services such as data communications and private business networks.

Data Communications Division Products

Asynchronous Pads
SP/830
SP/8300
MP/8300
Synchronous Pads
SP/8400- 3270 BSC III
SP/8400 - 3270 DSP
SP/8400 - 2780/3780
SP/8400 - SNA/SDLC
SP/8400 - Burroughs
MP/8400 - 3270 BSC III
MP/8400 - 3270 DSP
MP/8400 - 2780/3780
MP/8400 - SNA/SDLC
MP/8400 - Burroughs
Switching Processors
SP/8500 MP/8500
SPB/8500 MPB/8500
Multi-Protocol Switching Node
MPSN 8000
Network Control Center (NCC)
NCC1: Network Management and Configuration
NCC2: Network Billing and Statistics

Infinet Inc. Products

Modems
Trellis V.32
Dial Modem 224
Integrated Diagnostic Modems (IDM Series)
IDM 500 IDM 9600
IDM 2400 DIM 14.4
IDM 4800 IDM 556
Integrated Statistical Multiplexers (IDM Series)
ISM 300 ISM 700
ISM 600 ISM 900
Remote Dial Bridge
RDB 8000
Dial Backup Unit
DBU 368
Network Information System
NIS 90/70
NIS 90/50
NIS 90/40
Performance Measurement System
PMS - II
PMS - III
Network Control System
EMS - II

Memotec

1977 • Memotec Service Group is founded

1978 • Manufacturing plant, Montreal
- First X.25 product introduced

1979 • Division of International Systcoms Ltd.
- Marketing expands to the U.K., France and Germany

1980 • Expansion to Belgium, Holland and Switzerland

1981 • First U.S. sales office established
- Expansion in Italy, Austria and Denmark

1982 • New offices; Toronto and Denver, Colorado
- Honeywell service agreement signed (United States)
- Expansion to Japan, Singapore, Sweden and Venezuela

1983 • Memotec Data, Incorporated
- New offices established in Ottawa, Los Angeles and Dallas, Texas
- New President brings innovative marketing skills and corporate strategies

1984 • Outstanding performance is illustrated-revenues increase 150%
- Honeywell services extended to Canada

1985 • Record sales months
- Acquisition of Real Time Datapro Ltd.

1986 • Acquisition of Infinet, Inc.
- Company of the year award
- One of the top five, fastest growing companies in the Canadian computer industry
- Reached over thirty-five countries for international distribution
- America Award for export

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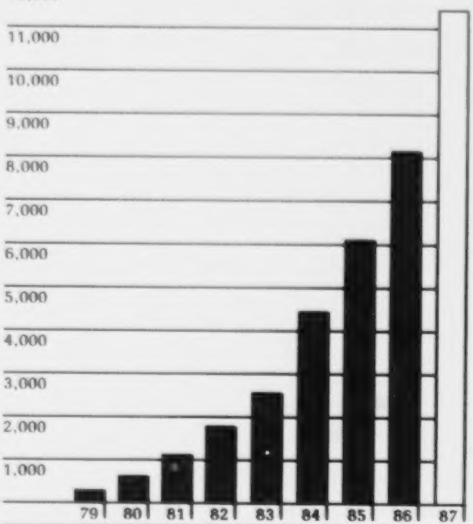
Communications Processors Installed Base

Data Communications Division



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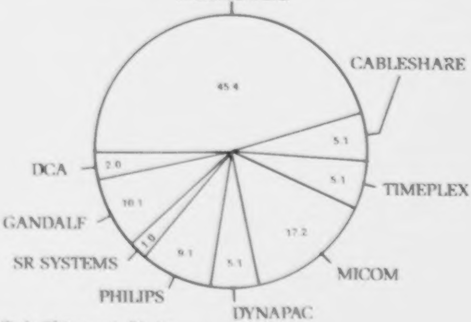
World-Wide Market Share

Data Communications Division



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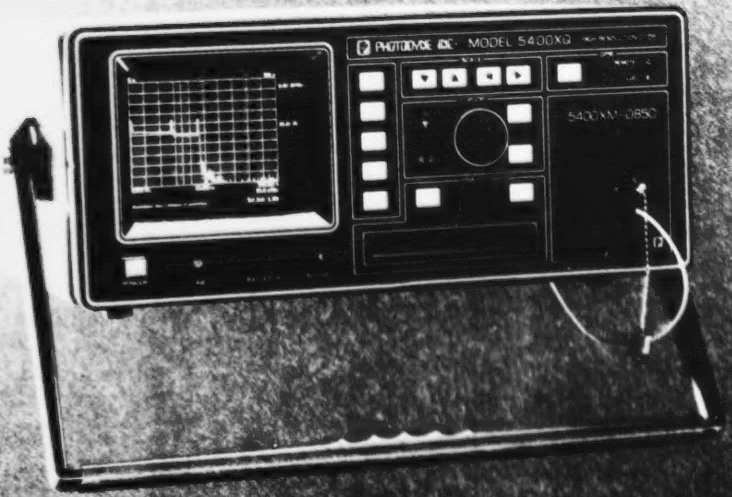
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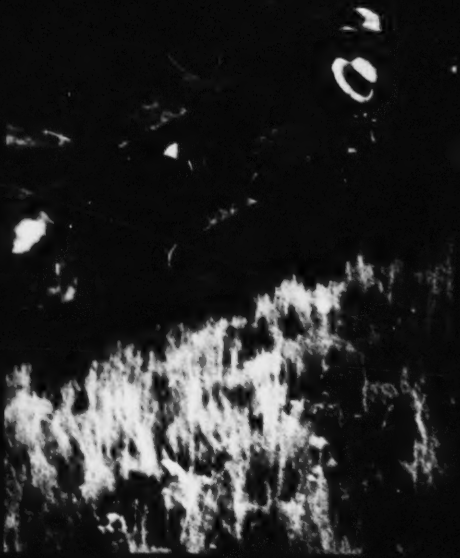
RURAL COMMUNICATIONS



Above: *A repeater pole being carried to the top of the 4,200-metre high Cerro Curri in the Andes for the installation of a point to multipoint TDMA (time division multiple access) microwave telecommunications system between the mountain villages of Peru and the outside world. Photo courtesy of SR Telecom.*

APPROPRIATE TECHNOLOGY FOR RURAL TELECOMMUNICATIONS

by Ann Lloyd

In recent years, rural telecommunications have become an area of special concern both for equipment suppliers and for PTTs in developing countries. As the problems common to all remote locations are identified, so manufacturers are responding with an increasingly wide range of solutions. Ann Lloyd, Advertising Manager of SR Telecom Inc., a Canadian company which specialises in rural telecommunications, outlines the planning priorities for rural networks.

AS INDICATED by the current rash of five-year plans for rural telecommunications around the developing world, this area of telecommunications had clearly become a major priority in many countries. Now that it has been recognised that the world's rural areas share problems of remote location, inaccessible terrain, sparse population and limited resources, the challenge is to find effective methods of providing telecommunications services to such regions.

In Brunei, for instance, houses are mainly built on stilts and the canals are severely tidal, making the use of cable totally impractical. In the mountainous areas of Turkey, the temperature can range from −40°C in winter to semi-tropical in summer. In Peru, repeaters have to be positioned as much as 4,200 metres above sea level in areas where there are virtually no utilities. Severe tropical rain-

Above: *An isolated subscriber in Turkey now connected to the telephone network through SR Telecom's microwave system. Photo courtesy of SR Telecom.*

storms have been known to wash away bridges and roads in Cameroon; villages in Zimbabwe are situated hundreds of kilometres apart across semi-desert. There are over 330 islands in the Yellow Sea requiring links to the mainland of South Korea. And, in Canada itself, the second largest country in the world, a third of its surface area, a landscape of scrub, tundra and waterways, is home to only 66,000 people.

The options available for solving these kinds of telecommunications challenges – microwave or cellular, digital or analogue, fibre optics or quartz regulated gateways, TDMA (time division multiple access) or satellite – are increasing all the time, especially now that more and more manufacturers are investing time and research in rural technology.

Taking the universal needs into consideration, however, both designers and purchasers of equipment have to remember certain priorities in planning for rural networks.

☐ Reliability. This is vitally important when gaining access to an installation may mean the hire of a helicopter at $450 an hour or a six-hour trek up a mountainside. Technical expertise is not abundant in remote areas and systems should be easily maintainable by indigenous labour if possible.

☐ Compatibility with existing technology. Lack of standardisation is a significant problem in remote areas. Considerable planning and international cooperation is crucial at an early stage to avoid an interfacing nightmare.

☐ Cost. The expense of developing small systems for remote areas may be just as much as for large systems, especially when increasingly complex services are required.

In addition to this are the requirements unique to remote locations. Installations in difficult terrain must be able to withstand climatic changes without extra cooling fans or other spare parts being required in an emergency. Equipment should be stored in weatherproof cabinets able to give protection against both extreme cold and heat.

Energy supply can also be a problem in areas being provided with a telephone service for the first time. The power supply may need to rely on wind or solar energy at best, a low and easily rechargeable electricity supply at worst.

Lack of standardisation is bound to cause interfacing problems with equipment. It would be too idealistic as well as unrealistic to expect networks to be unified – one has only to look at the range of systems in operation across Africa and the difficulties experienced by Panaftel. There is talk of standardising equipment in Africa with a central supply depot in Tanazania, but this would be a difficult task to achieve. In the meantime, while it has to be recognised that a range of technologies will continue to coexist in remote areas worldwide, any effective system has to have in-built flexibility in its basic technology.

Since the report of the Maitland Commission, much attention has been focused on the problem of rural communications in particular, and rural telecommunications packages are now being designed by most countries in the developed world. In many cases this has meant the change from analogue to digital where economically feasible, while others are still a long way from converting to digital switching systems.

Now that the dust is settling, priorities for developing countries are becoming more clearly defined. They are demanding a high level of sophisticated and reliable equipment to meet their unique requirements such as low power consumption and climate control. Whichever system is chosen, developing countries are keen on the transfer of technology and technological independence, and more and more licence to manufacture agreements are being signed between the original supplier and customer, particularly in the Far East. Most suppliers are now including training sessions for indigenous technicians and local engineers in their basic sales package, so that once systems are installed the customer is independent of any external and possibly expensive maintenance contracts. When such training programmes are provided, however, the local PTT must ensure that the trainees are not immediately reassigned so that the technical knowledge transfer is then lost.

Clearly there are now an increasing number of solutions being provided for remote telecommunications networks around the world. In turn, the needs of developing nations have been identified more precisely. Above all, the constant aim should be the provision of 'appropriate technology' – not necessarily the most expensive, the cheapest or the latest, but that which meets the unique demands inherent in bringing a service to the remotest points of the globe.

As cooperation and understanding grow between developed and developing nations, between supplier and customer, so a fully standardised telecommunications service will become more of a reality. In the meantime, however, the reality of working within the constraints of non-standard but flexible systems can prove to be equally rewarding and equally effective to all concerned. ☐

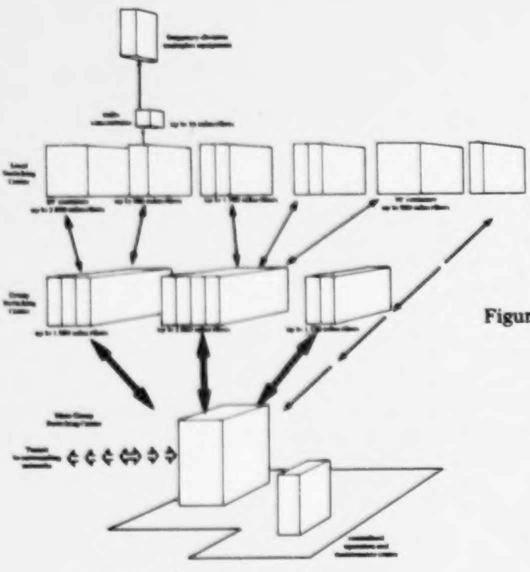


Figure 1: A rural network structure

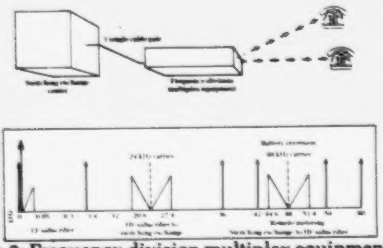


Figure 2: Frequency division multiplex equipment

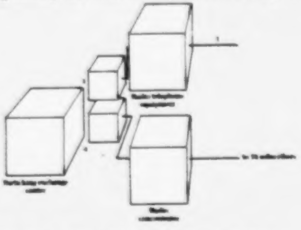


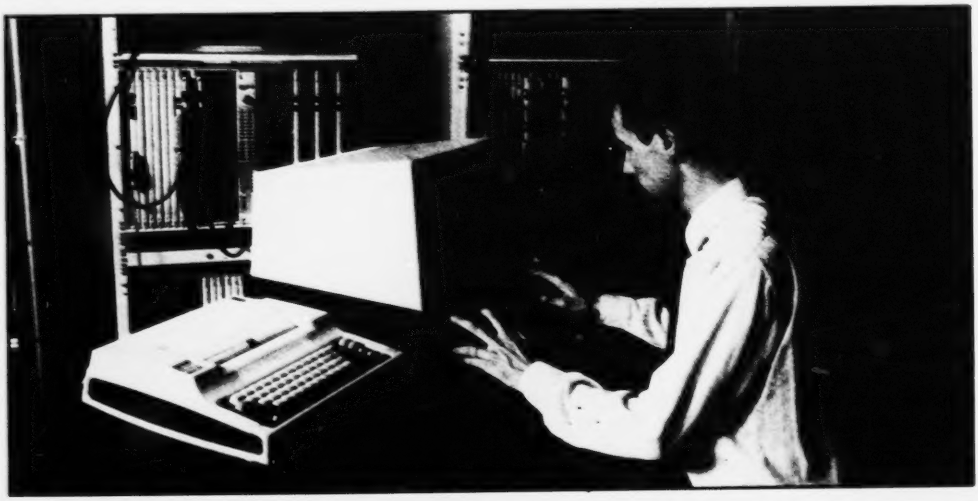
Figure 3: A radio telephone system

MEETING RURAL NEEDS

Rural telecommunications systems often have to contend with extreme climatic and geographic conditions, poor power supply and lack of human resources. F Leleux, Sales Manager of the Telecommunications Networks Department of Jeumont-Schneider, explains the problems and stresses the factors that need to be considered when planning a rural network.

by F Leleux

COMMUNICATIONS have always been an important factor in the social and economic exchanges of mankind. This is truer than ever today at every level of our daily life, whether in the routing of strategic information neces-



sary for making a vital decision in the ever-changing competitive world or for calling on emergency services in the presence of natural disasters.

Efficient communications are not only essential for urban areas, but also for rural areas. Yet, although the need to communicate is similar, the characteristics of rural telephony are different because of its climatic, geographic and socio-economic environment. Equipment designed for urban centres is incompatible because of its size, operational features, cost and absence of remote maintenance facilities. A rural communications system has to have versatility and adaptability – in other words, be modular and mobile – in order to be cost-effective. In addition, reliability and maintainability are two other major priorities of a rural network, since qualified staff may not always be available to manage and maintain equipment.

For maximum efficiency, the rural network plan should be part of the whole country's network plan, sharing the same objectives for quality of service in transmission performance, efficiency performance, function performance and service support performance.

However, rural areas have their own specific needs in relation to the type and availability of service, its accessibility and the charges that can be made. In order to amortise investments and provide a satisfactory and profitable service, the system to be implemented should take these into consideration.

For instance, rural areas are characterised by large distances between installations. Potential subscribers are scattered over a much wider geographical area than in urban areas, which results in the need for longer physical lines and a greater number of small capacity switching systems rather than large capacity ones.

Satisfactory service supposes that the different subsystems (i.e. the local centres) of the network are autonomous and do not rely on a transmission link connecting them to a higher hierarchy centre. Thus each subsystem, although part of a fully-integrated network, has its own dispatching and metering capability and is able to continue providing a service in case of transmission failure at a higher hierarchy centre.

Other constraints also have to be taken into consideration when a rural network is being planned. Extreme climatic and geographic conditions, for instance, may impose certain difficulties. In some countries, temperatures may range from -10°C to +50°C and relative humidity reach up to 95 per cent at 40°C. Air tends to have a high dust content in dry regions or a high salinity level in coastal zones. Torrential downpours can be found in tropical zones, with strong winds and frequent electrical storms. All these severe conditions make critical demands on the life and maintenance of the equipment.

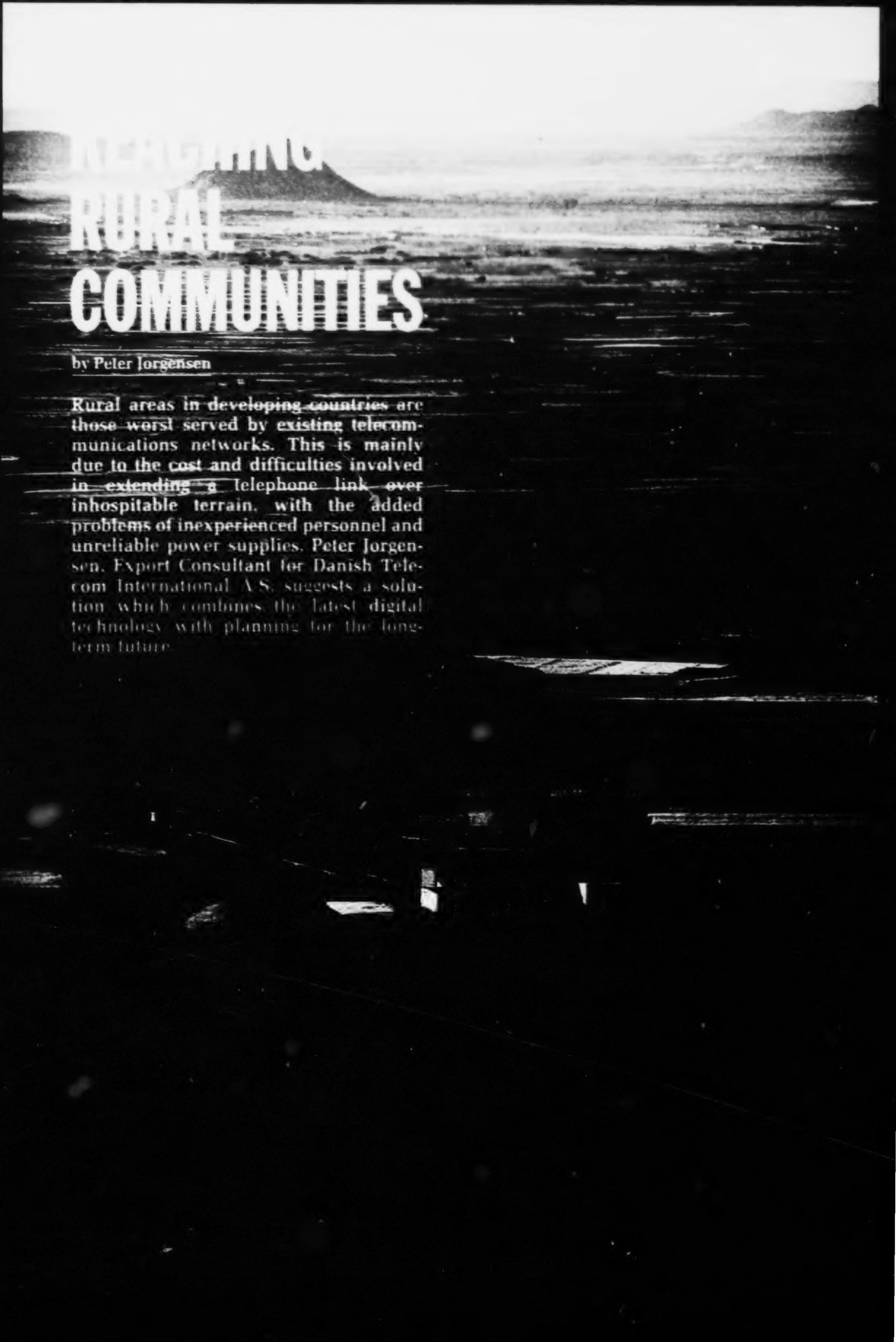
Primary power is usually scarce and the commercial power supply generally widely fluctuating and unreliable, with breakdowns of long duration. Batteries should be provided for back-up in case of primary power failure and, in areas lacking power supply, diesel engines, solar cell generators or wind generators should be considered.

The ideal equipment should take into account all these constraints, as well as being compact and easily manoeuvrable. This will allow for temporary installation and easy relocation of all or part of the system in the case of natural disasters (floods, earth slides, etc.), thus enabling continuity of service for emergency purposes.

A poor socio-economic environment may mean that qualified staff are not available to manage and maintain the equipment, mainly because they prefer to stay in urban centres. Ease of maintenance and, where possible, remote monitoring and testing, is therefore an important characteristic. The operation and maintenance philosophy behind these networks reflects the kind of service offered, its potential for expansion, the technology employed, manpower and investment policies. The cost per line is, for example, closely related to the maintenance support, which in itself represents a sizeable part of the total life cost of the network.

It is important for rural networks to allow for compatibility with both the existing network structure in the area (i.e. with the different types of switching systems, routing plans or numbering schemes which may already be in operation) and any future network structure (i.e. data and video transmission). It should have the capability to serve, with reliability and at minimum cost, a small number of subscribers scattered in remote areas and it should aim to have a high technology life, before the system becomes obsolete due to the availability of a newer and more cost-effective or suitable product.

Clearly, the advantages brought to rural people through such a telecommunications network are enormous. Rural economy is boosted, in turn generating rural employment and thus controlling rural-to-urban migration; the isolation of remote communities is reduced; and emergency services can be reached efficiently in the case of natural disasters or epidemics. □



REACHING RURAL COMMUNITIES

by Peter Jorgensen

Rural areas in developing countries are those worst served by existing telecommunications networks. This is mainly due to the cost and difficulties involved in extending a telephone link over inhospitable terrain, with the added problems of inexperienced personnel and unreliable power supplies. Peter Jorgensen, Export Consultant for Danish Telecom International A/S, suggests a solution which combines the latest digital technology with planning for the long-term future.

WITH today's possibilities of data storage, processing, retrieval and transfer, the accumulated experience of mankind is potentially available to every individual anywhere on earth. Every feature of the information society can be delivered even to rural areas, where the need for information is particularly high.

At the moment, however, the telephone network mainly connects people in North America, Europe, Japan and Australia. Representing only 20 per cent of the world's population, people in these countries have more than 90 per cent of the world's telephones.

Of the 3,500 million population of Asia, Africa and South and Central America, 1,000 million live in cities with some form of telecommunications facility. The rest live in the rural areas of these continents with virtually no form of telecommunications. This means that 55 per cent of the world's population, in the main the poorest part, can only use telecommunications facilities if they travel relatively long distances. Even postal services in the rural areas of most countries are similarly underdeveloped.

Good telecommunications in rural areas are a prerequisite for the expansion of trade and industry outside urban regions. They also improve the possibilities for providing social services. Extension of the telephone network in rural areas is a profitable investment from the point of view of the national economy. This view is often opposed by more short-term commercial arguments (e.g. that the investment cost per subscriber is high and income low), but they do not apply to overall profitability over a long period of time.

Developing countries, as well as many recently industrialised countries, are now faced with the task of automating their manual networks and extending them to new areas where telephone services have not previously been available. In developing countries the exploitation of new technology in the network is thus not tied to existing equipment to the same extent as in highly industrialised countries. Because of this it is possible to skip a generation of technological development and allow the latest technology to govern network design.

In many developing countries, the telephone service needs to be introduced to a large number of communities. Budget limitations often lead to expansion programmes with one public telephone per community. This would probably be a coin box set or a set with a subscriber's call-fee meter installed in a shop, for instance. More than one telephone is required in many cases, of course, but typically the telephone density will be low, even in areas with a large number of inhabitants.

Special demands are often placed on equipment and network design in developing countries. This is because there tends to be a lack of trained personnel, it is difficult to arrange a reliable power supply and climate and terrain often pose problems.

The use of remote units contributes to good network economy. Such units are economically viable for very small numbers of subscribers (down to a minimum of 30). They also make it possible to extend the exchange catchment area, thus reducing the cost per subscriber. In addition, technical development results in a gradual reduction of the volume of hardware.

The introduction of integrated digital switching and transmission systems offers many advantages. These include a high signalling capacity for the remote units in the network, facilitating centralised operation and maintenance. It also means that advanced subscriber services, offered by a central processor, can be used at considerable distances from the main exchange.

Jutland Telephone decided that an optimum solution for a network of this kind could not be reached with equipment available on the market. Consequently it set out to develop an entirely new network component.

Conceived as a system, this is an independent digital concentrator capable of connecting a substantial number of subscribers to the network via just a few pairs in a cable. It does so by means of a combination of digital switching and transmission. Time slots in a pulse code modulation (PCM) transmission system are automatically assigned to a subscriber when an off-hook situation is detected or an incoming call is received.

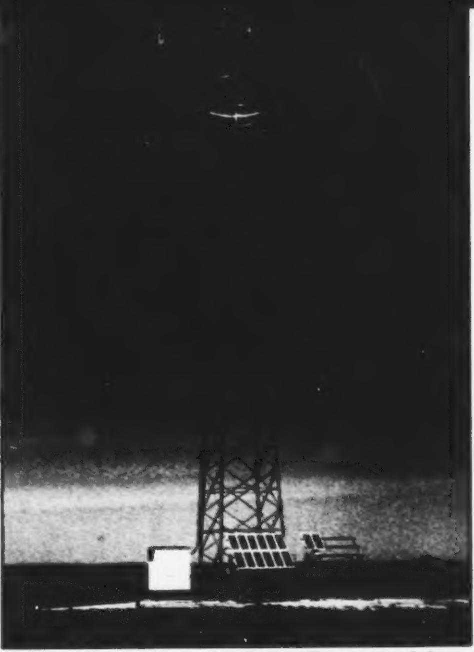
A system of this kind has many advantages. It ensures better utilisation of existing cables, fast and simple expansion of exchanges running out of capacity and early introduction of digital technology in remote areas. Its small size and ingenious design – it can be installed in a roadside cabinet or in existing exchange buildings – also guarantees flexibility. Its applications include upgrading of a network, increase in cable capacity, parallel exchange extension, a remote subscriber stage for digital exchanges, fast digitisation for sub-areas and, ultimately, adaptability to an integrated services digital network (ISDN). □

Left: *The majority of the population in Asia, Africa and South and Central America live in rural areas with limited if not negligible access to telecommunications facilities. Photo courtesy of Cable & Wireless.*

PROVIDING A RURAL NETWORK

by F A Campbell

As in other continents, the rural areas of Australia have in the past suffered from poor telecommunications facilities. F A Campbell of Telecom Australia (International) Ltd explains how new technology is coming to the rescue with a range of options for extending the existing network.



Above: A typical repeater unit will consist of three units: a weatherproof cabinet which houses the radio equipment and batteries, a solar array and a mast of suitable height to support the antennae.

THE provision of communications services in the rural areas of Australia has perennially presented major problems. While the nature of these areas varies widely, the general characteristics which present a particular challenge are low population density, great distances and harsh terrain.

A telecommunications network can be see as a mesh of nodes (telephone exchanges) and interconnecting transmission links carrying voice and data traffic. Until recently, the Australian network was based on analogue technology, with electromechanical exchanges and analogue transmission systems, which compared favourably with other systems in use elsewhere in the world.

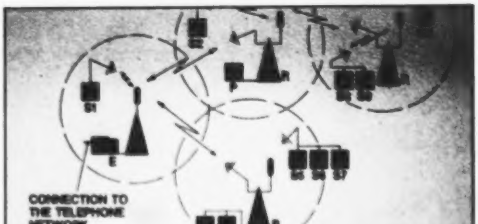
The current thrust in network development is to develop an 'overlay' digital network which will result in major long-term economies as well as the more effective carriage of a range of data services integrated with traditional voice services.

In urban and more closely settled rural areas the telecommunications network provides many alternate transmission paths interconnecting between the nodes. In sparsely populated areas, there are necessarily fewer and smaller nodes and the transmission paths become progressively thinner as they extend further from the major centres.

The rural exchanges can serve large areas, with customer distribution costs becoming higher as the density of customers decreases. L M Ericsson crossbar switching equipment is at present used in rural exchanges. However Telecom, together with L M Ericsson, is currently developing a small digital rural exchange (called AXE Rural), which will be installed where 60 to 1,000 lines are required.

The transmission systems between exchanges become proportionately more expensive per circuit as the routes become longer and thinner. This also applies to long lines from the exchange to customer premises, and radio systems have been developed to minimise the cost for longer lines in the customer distribution network (i.e. the exchange to customer link). This allows larger exchange areas to be employed and helps to minimise the costs of establishing or extending the network. The low density of customer distribution in sparse rural and remote areas is such that, without radio systems, copper wire technology would be prohibitively expensive.

The key development which permits the extension of modern communication services into the more remote areas is the digital radio concentrator system (DRCS). In addition, satellite technology will be used in certain circumstances.



Above: A digital radio concentrator system (DRCS) is ideal for areas of low population density with long distances between individual customers.

Choice of technology

Telecom Australia has a range of options available to provide telecommunications services to customers in rural and remote areas. This is a brief summary of the possible configurations.

☐ copper cables can provide a service to customers within the immediate vicinity of a telephone exchange. As the distance between customers becomes greater, the costs rise rapidly.

☐ single circuit analogue radio systems can provide a service to an individual customer located up to about 40km from a suitable entry point to the national network. This distance may be extended to about 80km if a repeater is used.

☐ small capacity radio systems can provide a link from the existing national network for a variety of purposes. These include links to remotely sited telephone exchanges at small settlements, links to a remotely sited analogue radio concentrator or dedicated circuits to high calling rate customers.

☐ analogue radio concentrator systems are useful in a number of configurations but particularly where a small cluster of up to about 50 individual customers is located within a 40km radius of the base station.

☐ digital radio concentrator systems (DRCS) become increasingly useful and economic in more thinly populated, inaccessible locations. A DRCS is able to provide a service to customers located up to 600km from a suitable entry point to the national network.

The national communications satellite (Aussat) will generally not be used to provide services to rural and remote areas under normal connection arrangements. However, by way of negotiated commercial projects, a range of services tailored to meet customers' requirements will be available, including remotely located telephone exchanges. In certain circumstances it will be used for the early provision of services.

The particular technical option chosen from the range of configurations outlined above will depend upon economic and strategic factors and on the need to satisfy customer requirements. A basic aim in the selection of the appropriate technological option is to provide a 'transparent' service, enabling the customers to have a wide choice in their selection of terminal equipment and attachments and a high standard of communication services.

Digital radio concentrator systems (DRCS)

This system was conceived and specified by Telecom in the 1970s to meet the needs of customers in the remote areas of Australia's outback. Its detailed design, development and manufacture was undertaken by the Nippon Electric Company (NEC). The DRCS is particularly suitable to cover areas of low population density with great distances between individual customers, e.g. pastoral stations, aboriginal communities or mining ventures.

The DRCS consists of three main building blocks: the customer station, the repeater station and the exchange unit. The latter is located at the terminal exchange, with individual repeaters extending the system to serve the DRCS customers located in the repeater's service area. The customer stations are located at or near the customers' premises.

The radio path is taken out to the customer by radio repeater stations about 40-50km apart. Up to 13 repeaters can be used in tandem in a DRCS giving up to 600km distance between the exchange and the most distant customer. The systems operate in the 500 MHz and 1500 MHz bands.

The DRCS is capable of carrying a maximum of 127 customers, although it is planned that for the initial implementation each DRCS should have a maximum of between 50 and 80 customers. This figure will allow the system to accommodate unforeseen patterns in the traffic generated by customers and in the long term will allow it to provide for the connection of additional customers within its service areas.

Each customer on a DRCS is either cabled from a nearby repeater, if within 4.5km, or connected to it by radio. In the latter case the customer station is located on the customer's premises and within line of sight (about 30-40km) of the repeater tower. It can be seen that by locating repeater stations to suit the spread of customers and the terrain (viz. using raised ground where available), a DRCS can serve customers over a vast area.

The exchange unit is in two main parts: the concentrator, which controls the allocation of the 15 timeslots to the customers' individual lines (127 maximum) and the time diversion multiplex (TDM) controller, which provides signalling control over the radio portion of the system. The TDM controller includes a radio transreceiver.

The repeater unit receives the 'downstream' signal transmitted by the exchange unit and, after regeneration, retransmits that signal onward using a different frequency to serve the customer units within its service area and the next repeater further out, if there is one. The signals from the units in the upstream direction are also regenerated and retransmitted towards the exchange unit.

A typical repeater station will consist of three units: a weatherproof cabinet which houses the radio equipment and batteries, a solar array and a mast of suitable height to support the antennae.

There will be at least two antennae for each repeater. An omni-directional antenna will be used for communicating with the customer units in the repeater service area and any downstream repeaters further from the exchange. A directional antenna will be used for communicating with the next upstream repeater or the exchange unit.

The repeater unit will be housed, along with its associated drop-out unit, batteries, etc., in a weatherproof steel cabinet. Because of the high temperatures encountered in the Australian outback this will be completely shrouded by a vented sunshade. When open, the doors of the cabinet will form a sunshade for the staff working on the repeater. The solar array will be mouned adjacent to the cabinet.

If multi-customer drop-out units are required, they will be installed in a similar cabinet, with their batteries, battery charging equipment, etc., next to the repeater unit cabinet.

The cabinets will be located near the base of the repeater mast which, in some cases, will be as high as 90 metres.

The customer unit consists of a radio transceiver and one or more customer drop-out units, with each of the latter serving one telephone set. The maximum number of drop-out units that can be connected to one customer unit or repeater unit is 21.

A customer station will usually consist of a weatherproof pre-wired equipment cabinet to house the DRCS customer unit, batteries and the battery charging controller. There will also be an antenna support and a solar array.

The DRCS delivers a wide range of modern telecommunications services. Through DRCS, customers in remote areas can have access to services such as ISD (international subscriber dialling), STD (subscriber trunk dialling) and 008 (inward wide area telephone service). The DRCS can also be configured to provide telex services.

Analogue radio concentrator systems (ARCS)

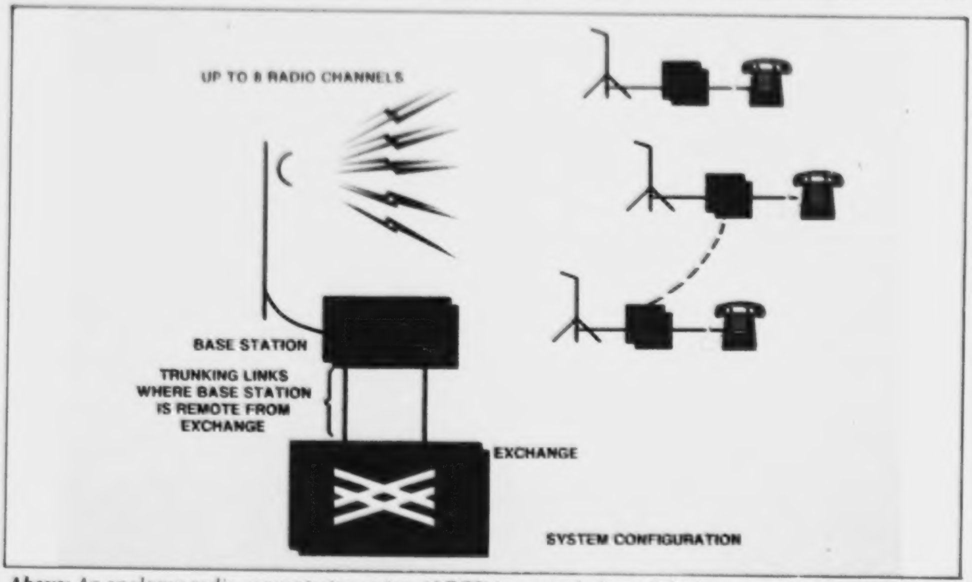
Analogue concentrator systems are useful in a number of configurations, but particularly where a small cluster of up to about 50 customers is located within a 40km radius of the base station.

The ARCS consists of

☐ a base radio station. This may be located at the terminal exchange or at a site remote from the terminal exchange.

☐ group exchange equipment. This is normal-

***Above:** A customer station will usually consist of a weatherproof pre-wired equipment cabinet to house the DRCS customer unit, batteries and the battery charging controller. There will also be an antenna support and a solar array.*



Above: *An analogue radio concentrator system (ARCS) is particularly useful where a small cluster of up to 50 customers is located within a 40km radius of the base station.*

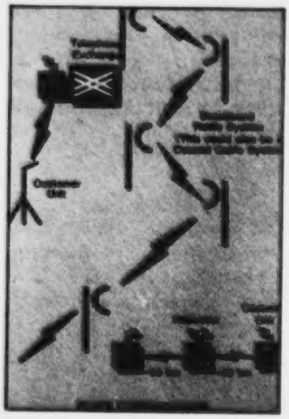
ly located at the terminal exchange.

☐ a customer unit. This is located as close as practical to the customer's premises.

The ARCS provides a limited number of radio telephone circuits between each service connected to the system and the base radio station. Each service has access to all these radio telephone circuits on a demand assignment basis.

The number of radio telephone circuits to be provided is a minimum of four and a maximum of eight and provision is made to allow an ARCS to be expanded in increments of one. In general a maximum of 50 customers can be connected to an ARCS.

Under conditions where customer calling rates are high or particular calling patterns exist, lower system capacities will result. Coin telephones and some business telephones may have calling rates much higher than normal and the connection of such services to an ARCS could cause excessive levels of congestion. In these cases, the provision of these high calling rate services by other means, such as an exclusive single channel customer radio system, is warranted.



Left: *A single circuit analogue radio system (SCARS) can provide an exclusive telephone circuit between a telephone customer and a suitable entry point to the network.*

In cases where the base radio station is located at a distance from the telephone exchange, links will be required between the exchange and the base radio station.

The exact nature of these links will depend on distance and location, but will normally be any of the following types:

☐ carrier systems

☐ radio links

☐ physical lines

The base radio station is usually centrally located within its radio service area and the customers located within a radio 'line of sight' path. The radio service area covered by a base station is of course dependent on the height of the antennae above ground but is normally about 40km.

Single circuit analogue radio systems (SCARS)

This system is able to provide an exclusive telephone circuit between a telephone customer and a suitable entry point to the network. The latter could be a telephone exchange or a suitable point along a radio relay route.

It consists of

☐ a customer unit. This is provided at the customer's premises.

☐ an exchange unit. This is similar to the customer unit and is provided at the point of entry to the network.

☐ a repeater unit. This consists of two back-to-back exchange units.

The radio hop length using a SCARS is dependent upon the terrain and the height of the antenna used, but it is usually about 40km over fairly flat terrain.

Repeaters can be used with SCARS to extend the service distance from the network connection point. It is desirable that only one repeater be used, which means that in typical flat rural terrain a service can be provided within about 80km from the network connection point.

The point where the SCARS connects into the network could be some hundreds of kilometres from a telephone exchange. This can be achieved by associating direct-to-line (DTL) multiplex equipment with a broadband radio-relay system.

Small capacity radio systems

Small capacity radio systems may be used in a variety of applications. This includes the provision of links to remotely located ARCS base stations or their use in conjunction with the DRCS to meet higher demand than estimated maximum capacity. The small capacity radio system enables high calling rate services to be provided with a dedicated circuit. It may also be used to locate the TDM controller of DRCS remotely from the concentrator unit at the exchange or an ARCS base station remotely from the exchange.

National communications satellie

Australia's first domestic satellites (Aussat) are now operational. The satellite communications offered by Telecom is the Iterra Network Service (INS). This can provide telephony, data and text facilities, connected to the national switched telephone network.

The Telecom INS services are provided via a number of customer earth stations and one main earth station located at Bendigo, Victoria. The latter provides the interface between the satellite network and the terrestrial network.

Customer earth stations are available with from one to 14 circuit capacity, according to customers' requirements. The circuits can be used simply as exchange lines for telephones, small business systems, PABXs and other terminal equipment, or as junction circuits for local telephone exchanges provided by Telecom.

The cost of a satellite service will generally preclude its use as the normal means for providing basic remote area telecommunications services. The DRCS offers better performance at less cost in the vast majority of applications. However, customers who wish to have service in advance of planned network expansion are able to opt for the satellite service at a price which reflects the cost of its establishment.

Power supplies

In many rural areas and most remote areas, reliable 240 V power is not available and alternative means are therefore necessary to provide power for telecommunications plant.

Over recent years Telecom has been a leader in the successful development of solar power to the point where a range of equipment can now be powered in this way. Several major trunk radio systems, as well as many customer radio services, are already solar powered.

In general a solar power supply will be used where a repeater station or customer station is remote from reliable commercial power. This will require batteries with an eight-day reserve to accommodate the variation in the seasons and the weather, which influences the energy available from the sun.

Where a larger power supply is required, Telecom has successfully used diesel engines to provide the prime power. However, such systems are expensive to provide, maintain and support. To address the problems posed by these installations Telecom has been developing and implementing the use of hybrid power systems using combinations of solar, wind, diesel and battery technologies.

Conclusion

By 1990, Telecom aims to have completed a modern, automatic service linking Australians throughout the continent and is investing some $275 million in the Rural and Remote Area programme to achieve this goal. This involves the conversion of existing manual services to automatic and the provision of services to all isolated communities in the remote areas of Australia through the use of the latest techniques. ☐

This paper is based on a presentation given by the author at Communicasia 1986. The assistance of John Burton and his permission to use extracts from his paper 'Telecommunications in the Outback' is gratefully acknowledged.

COMMUNICATIONS TECHNOLOGY
BY SEL

Remote is no longer a synonym for isolated

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Remote subscribers will have the possibility to use their own telephone or a common coinbox. Furthermore, a complete PABX, telex or telefax can be connected to Rurtel. Data and video transmission is also possible.

Rurtel is SEL's contribution to solve the communication problems of rural areas all over the world.

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Major System Data

Maximum distance from an existing telephone exchange	approx. 300 km
Maximum number of subscribers within one network	250
Maximum number of subscribers per remote subscriber station	24
Maximum distance between remote subscriber and remote subscriber station	12 km
Frequency range	1.5 and 2.4 GHz

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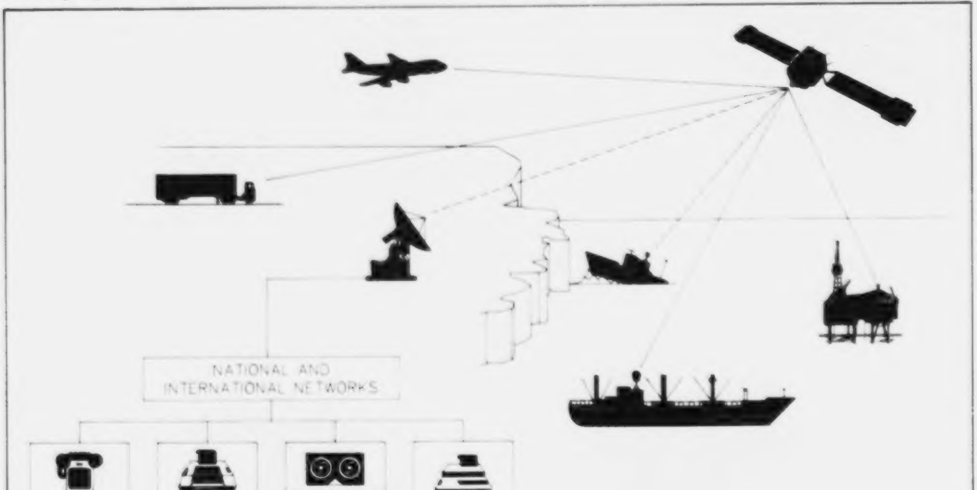
MOBILE TELECOMMUNICATIONS

A NEW MIRACLE FOR MOBILE COMMUNICATIONS

by Olof Lundberg

Since its establishment eight years ago, Inmarsat, the International Maritime Satellite Organisation, has expanded its concerns to include aeronautical and land mobile communications worldwide. Olof Lundberg, Director General of Inmarsat, reports on its most recent technological achievement, the portable mobile earth station, Standard C, and its implications for all aspects of mobile communications.


NATIONAL AND INTERNATIONAL NETWORKS
Telephone
Facsimile
Low medium and high-speed data
Telex

***Below:** Communications facilities offered by the Inmarsat system could be of great benefit to shipping, offshore and aviation industries in developing countries.*

IMAGINE a truck, loaded with food and medical supplies, driving across the African deserts to deliver relief to a refugee camp. In the middle of nowhere, hundreds of miles from the nearest town, the truck breaks down. How can it get help before the food and supplies become unusable?

Imagine a small fishing boat, groaning under the day's catch, making its way back to shore in the early evening. The engine stops. Water has got into the fuel lines. As the sun disappears into the twilight, the three-man crew find themselves alone, still 30 miles off the coast. The VHF operator on shore has called it a day. How can they get assistance?

Imagine a volcano erupting in South America, engulfing a town in lava and mud, cutting off the roads, power lines and communications links with the outside world. People will die without immediate help, but how can they make their plight known fast enough?

Finally, imagine a device, not much larger than this book, which can send and receive messages to anyone in the world at any time. It can be taken on a boat, on a truck, up a mountain, across deserts. It comes equipped with a keyboard, a small antenna and, in a matter of seconds, it can send a message for help.

This miracle of technology is no dream. It exists now and its usefulness has been demonstrated around the world. Called Standard C, this device will be commercially available in late 1987 for about $4,000 or less. A prototype has been developed by Inmarsat, and built at a cost of about $20,000 in the organisation's laboratory in London.

Although Standard C was designed for use

Left: *The maritime model of a Standard C earth station is so small that it can be carried even in a liferaft.*

on the smallest of vessels, including yachts, fishing boats and liferaft, it may have applications far beyond the maritime environment. Considerable interest in the easily portable earth station has been generated since Inmarsat began demonstrating its prototype a year ago and several manufacturers are now developing commercial versions.

Standard C is one of several services available from Inmarsat, which was established in 1979 by the world community to improve maritime communications through the use of satellites. By last November more than 5,000 vessels worldwide were using its Inmarsat system.

All of these vessels are equipped with a Standard A ship earth station, which has a one-metre parabolic antenna housed in a radome above decks. Standard A provides telephone, telex and data communications. Ship earth stations of this kind are produced by about a dozen different manufacturers at competitive prices of about $30,000.

At least two of those manufacturers now produce suitcase versions of Standard A, weighing about 50kg, which contain the antenna and associated electronics. The antenna can be erected and made operational within about 15 minutes. Such portable Standard As proved their versatility and reliability in the days following the earthquake which struck Mexico City in September 1985 and cut off its international telecommunications links. They were also used after the volcanic eruption in Armero in Colombia about a month later.

Among the more unusual applications of Standard A was when it was carried aloft on a record-breaking transatlantic balloon flight in September 1986, which went from Canada to Amsterdam in 51 hours. It was also used during the French project Sahel '84, when a convoy of lorries crossed the Sahel from Mauritania to Niger, delivering food and medical supplies. An application for its use in a railway construction project in Mozambique has been approved and numerous research stations in Antarctica have installed Standard As.

These applications are in addition to the oil tankers, offshore drilling rigs, passenger ships, cargo vessels, container ships, etc., which are equipped with ship earth stations so that they have instant, reliable communications with their offices ashore or, in the event of an emergency, with a rescue coordination station.

The number of ships equipped with ship earth stations is expected to grow even more rapidly in the 1990s with the advent of the Future Global Maritime Distress and Safety System (FGMDSS), now planned for introduction in 1991 by the International Maritime Organisation (IMO). The FGMDSS is aimed at improving maritime safety and rescue procedures and will rely heavily on satellite communications. Ships over 300 tons will be required to fit communications equipment according to the areas of the world in which they operate. Area A3, for instance, which is

***Above:* This portable Standard A mobile earth station can be erected in 15 minutes, making it ideal for use in disaster or emergency relief communications. It provides the full range of telephone, telex and data communications facilities.**

mid-ocean, is defined as being within geostationary satellite coverage, but beyond reach of VHF or MF radio. Ships will have the choice of fitting HF radio, a Standard A ship earth station or Standard C.

Developing countries, notably those in Africa and in the Asia-Pacific Region, will be faced with a choice as a result of the FGMDSS – either to upgrade their existing conventional maritime communications systems or to leapfrog a generation of technology and go directly into satellite technology. Clearly, Inmarsat believes they should take the latter option. Indeed, some countries have already declared that their coastal zones will be designated as Area A3, rather than Area A1 (VHF coverage) or Area A2 (MF coverage).

Improving maritime communications in developing countries remains a formidable challenge. The International Telecommunication Union (ITU) and IMO are, however, able to provide impartial, expert advice to those countries in deciding how to allocate scarce foreign currency.

Aeronautical applications

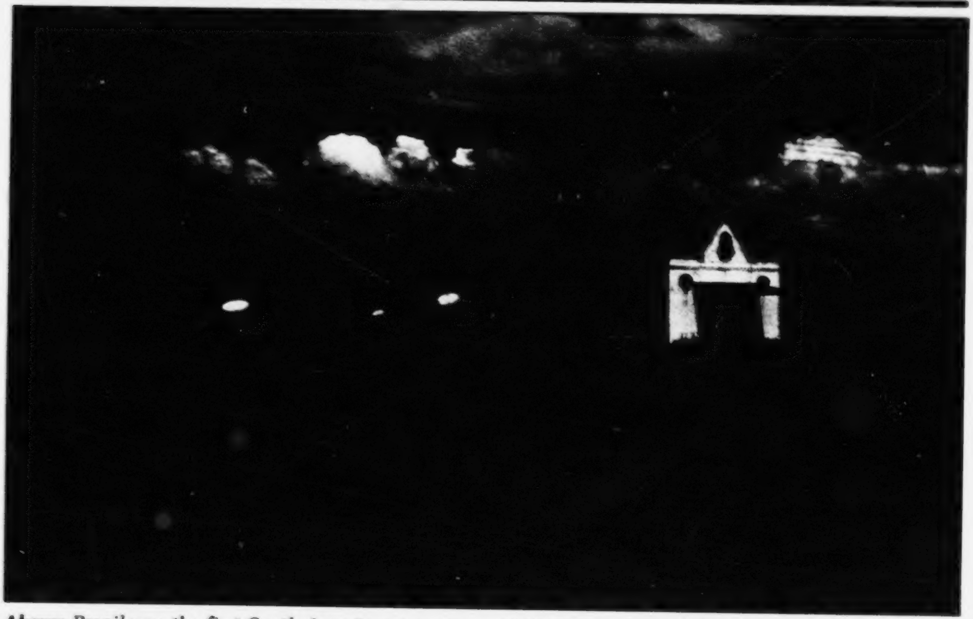
In October 1985, the Fourth Assembly of Parties amended the Inmarsat Convention so that the system could be used to provide satellite communications to the aviation community, for air traffic control, airline operations and passenger communications.

This followed several years of discussions and consultations with the International Civil Aviation Organisation (ICAO), the International Air Transport Association (IATA), airlines, antenna and avionics manufacturers and others. Inmarsat prepared and circulated widely for comment a description of a proposed aeronautical satellite communications system and the economies of scale which could be achieved by the maritime and aviation communities in sharing a common satellite system.

Inmarsat has also been participating in the Airlines Electronic Engineering Committee (AEEC) and ICAO's Special Committee on Future Air Navigation Systems (FANS), two important industrial bodies which will define the 'form, fit and function' of the antennae and avionics and required navigation performance capability (RNPC) of an aeronautical system.

It has also made available free use of its satellite system for experiments, trials and demonstrations of aeronautical satellite communications. Virtually every such test since the mid-1970s has used Inmarsat. A trial by the Société Internationale de Telecommunications Aeronautiques (SITA), a cooperative of about 300 airlines from 170 countries, is expected to get underway this year.

In November 1986, Inmarsat announced its plans to award contracts worth $3.3 million to various avionics manufacturers, including



***Above:** Brazil was the first South American country to install a coastal earth station. It was sited at Tangua, where there were already several Intelsat dishes.*

Collins, Racal, Ball Aerospace and E-Systems, to accelerate the development of satellite communications equipment for aircraft. A pre-operational service is expected to begin in late 1987 or early 1988. A number of airlines have indicated their intent to use Inmarsat, including the Soviet airline, Aeroflot, the world's largest, for voice and data services.

Several countries, including Argentina, Japan, Kuwait, Singapore, the United Kingdom, the United States and the USSR, have announced plans to provide the ground earth station services necessary to route a telephone or data communications call between aircraft and the terrestrial networks.

As with maritime applications, it is not necessary for every country to have a ground earth station in order to have access to the Inmarsat system. Calls can be routed through the closest or most competitive ground earth station to the international terrestrial networks.

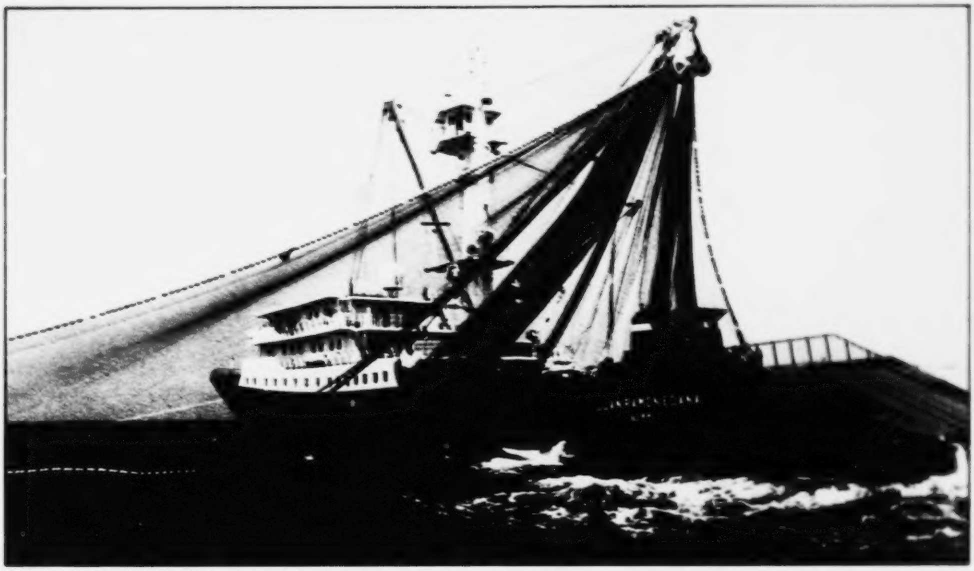
Inmarsat's aeronautical developments hold the promise of significant improvements in aeronautical coverage for developing countries, especially those in Africa, the Indian Ocean region and Asia/Pacific region, where the existing aeronautical communications systems are less than perfect. The Inmarsat system could be used to provide a full range of communications, navigation and surveillance (CNS) functions. Initial use of the system is expected to be for automatic dependent surveillance (ADS) over oceans and remote areas, in which the aircraft's position and other information is automatically relayed via satellite data link.

Land mobile possibilities

While use of Inmarsat could make a significant improvement in the maritime and aeronautical communications of developing countries, it may be that Standard C's use in a land mobile environment will prove to be of greatest interest to developing countries, because of its low cost and the ease with which it could be used for mobile purposes. Inmarsat already provides access to its system for disaster relief and other emergency communications on land.

There is, however, no international allocation for land mobile satellite communications, although the Mobile World Administrative Radio Conference (M-WARC) being held in Geneva in September may make such an allocation.

Inmarsat does not favour a reallocation or sharing of the existing maritime or aeronautical mobile satellite communications bands, which stretch from 1530 to 1559 MHz and from 1626.5 to 1660.5 MHz in the L-band, since it is likely that all of those allocations will be needed by their respective communities. Inmarsat would, however, have minimal difficulty in seeing a small allocation, on a secondary basis, in the maritime band for low speed, thin-route land mobile message com-



Above:* *A fishing vessel's use of satellite communications is revealed by the characteristic mushroom-shaped radome above decks.

munications of the Standard C variety, though land mobile satellite telephony services would require a much greater amount of spectrum than could be accommodated. Hence, Inmarsat favours a separate allocation for land mobile telephony, preferably near the maritime and aeronautical frequencies at L-band.

If provision is made for land mobile satellite communications, Inmarsat presumes that its signatories and parties would want it to provide such services and would, accordingly, amend the Convention and Operating Agreement in due course. Until then, Inmarsat would continue to provide land mobile on an exceptional and pre-emptible basis, as requested to do so by its signatories or recognised telecommunications entities in non-member countries.

European, North American and Indian entities have expressed an interest in using Standard C in certain land mobile trials and a number of such trials may well soon be at an advanced stage of preparation.

Land mobile satellite communications would not be as cost-effective or as spectrum efficient as cellular radio, especially in densely populated areas. Its chief advantage lies in remote and rural areas, where no reasonable alternative communications exist. Although there is growing interest in using cellular radio in these areas in developing countries, sometimes instead of the fixed services, this may not be the most economical solution, particularly if a cellular radio system does not already exist in the urban areas.

Navigation services

Developing countries may also be interested in exploring the potential for using Inmarsat for navigation and/or radiodetermination satellite services (RDSS), something which Inmarsat aims to provide and has plans to test and demonstrate this year.

The satellite system could be used to provide three types of such services. First is position relay, where an existing Omega, Loran-C, GPS or other navigation device is interfaced to a mobile earth station. Several Standard A manufacturers have included an interface so that the ship earth station automatically relays its position at pre-programmed intervals to shore authorities. Alternatively, a shipowner could, for example, 'poll' his ship(s), so that the position is relayed to him at his request.

The second type is ranging. A well-known technique, this determines a user's position by measuring the time taken for a signal transmitted simultaneously to the mobile via at least two different satellites to be returned to the originating station. This gives two or more lines of position which can be used to compute the vessel's position. Inmarsat intends to carry out tests and demonstrations this year to determine what accuracies are possible via ranging.

Third is to provide an 'integrity' channel for the US Global Positioning System (GPS), which would monitor the integrity of the

228

system. This would provide users with benchmark data from standard stations, thus enabling them to verify their own readings automatically. If one of the GPS satellites failed, the dedicated Inmarsat channel could be used to report the failure within 10 seconds.

Developing countries and Inmarsat

Inmarsat's services are rather specialised, and thus will appeal mainly to specialised users in developing countries, notably their shipping, offshore and aviation industries, rather than to the general telecommunications markets. Nevertheless, efficient telecommunications can yield substantial benefits when compared to the cost of investment involved. Some studies have shown that the benefit/cost ratio can be as high as 50:1. Unfortunately, mobile services such as maritime and aeronautical tend to be overlooked as priorities in improving telecommunications in developing countries, despite their key importance for trade and transport.

Developing countries could facilitate trade and transport to some degree by taking two relatively small steps. One is to sign an International Agreement on the Use of Inmarsat Ship Earth Stations within Territorial Seas and Ports, the purpose of which is self-explanatory. Some countries' regulations currently prevent vessels using ship earth stations in ports and territorial waters, with the result that the ship can be delayed in port. Such regulations may actually be harming the economy of developing countries.

A second step would be to open a shore-to-ship calling service via satellite. Typically, this step involves relatively straightforward, mainly administrative measures by the developing country to make operating and/or routing agreements with at least one coast earth station in each ocean region. Each ocean region in the Inmarsat system has the equivalent of a country code for telex and telephone calls, which precedes the number of the ship earth station. Providing for such calls should be a source of new revenue for the countries concerned and would help to integrate ship earth stations into the national and international telecommunications networks.

While Inmarsat encourages all countries to take these two steps – and many have done so already – it also hopes that an increasing number will become members of the organisation, in the strong belief that membership brings many benefits to the participants.

Inmarsat now has 48 member countries, 20 more than when it came into being in July 1979. Each country becomes a party to the Inmarsat Convention and nominates a signatory (usually, but not always the PTT) to the Operating Agreement. Signatories invest in the organisation according to their usage of the system.

Membership of the organisation offers several benefits. For example, Inmarsat is obliged to repay signatories their investment in the system, with a 14 per cent return. Revenues in excess of Inmarsat's budgetary needs are used to stabilise or lower space segment charges, as occurred in January 1986.

Member countries receive all documentation produced by the organisation, which helps them to have a better understanding of new developments in mobile satellite communications.

All member countries are entitled to be represented at the Assembly of Parties, which meets once every two years. Each country, however much they use the system, has one vote. Those 18 signatories, or groups of signatories, with the largest investment shares, plus four others elected by the assembly on a geographical basis and with due regard for the interests of developing countries, are represented at the Council, which meets at least three times a year. Hence, member countries are able to put forward ideas for and to influence the development of the organisation and the mobile satellite system.

Inmarsat recruits its staff from around the world. More than 30 nationalities are represented at its headquarters in London which ensures that the organisation understands and is sympathetic to the telecommunications needs of all countries as well as their differing socio-economic and political circumstances. Inmarsat is the only satellite organisation in which both the United States and the USSR participate, for example.

Although Inmarsat is still a young organisation, having been established in 1979 and begun operations in February 1982, one of its priorities is to increase its membership, especially in the developing countries. It is concerned, for instance, that so far only five of the 50 countries in Africa are members and only three of the 20 countries in Central and South America. With the development of new services, in addition to its maritime services, Inmarsat believes that more countries will see the value of joining the organisation. For Inmarsat to be successful in spreading the considerable benefits of mobile satellite communications, and to meet the ideals of multilateral cooperation which inspired the creation of the organisation, it needs the support of all countries through their membership and active participation. ☐

Above: *An operator's console, located in the network's communications centre, should be able to monitor, test and control all the mobile stations.*

CONTROLLING A MOBILE RADIO NETWORK

by R Jauch

Potential customers for mobile radio systems usually have a very clear idea of how they want to use a network. Increasingly this means that manufacturers should be designing mobile networks with particular users' needs in mind. R Jauch, of the Swiss telecommunications manufacturer, Brown Boveri & Co Ltd, summarises the expectations of mobile radio users and describes one network in operation.

ORGANISATIONS operating with mobile units have long relied on radio networks for the transmission of instructions and important information. Besides the public cellular radio telephone networks, railways, transport operators, power utilities, security organisations and so on still consider private radio systems to be an essential means of communication. The more so as only private networks make full allowance for operational priorities.

Although used originally, and almost exclusively, for voice transmission, mobile radio networks now have additional functions, and it is necessary today to adopt a more general approach to customers' problems. Increasingly, users require radio equipment to be adapted precisely to the operational duties they have in mind. This means that the control duties and the transmission must be treated with equal importance and that, to accomplish this economically, programmable control systems must be used.

Particular features which users expect today are:

☐ uninterrupted radio communication in a defined service area with a minimum number of frequencies.

☐ easy, ergonomic operation, enabling users to be trained quickly in the system and operating mishaps to be avoided.

☐ high availability. Despite high reliability being required of the system components, service aids must ensure that any faults that do occur are quickly detected and localised.

☐ low purchasing, operating and maintenance costs. A major share of the cost of large-scale radio networks is for the lines used to control the base stations. The remote control system has to be optimised to minimise the number of lines needed.

☐ voice and data communication. Voice communication is still the most important medium used for transmitting information. Hwever, repetitive, routine messages can be transmitted as codes in a much shorter time, and processed in the control centre. In some cases, access to a database via mobile data terminals is also required.

☐ speech scrambling. Eavesdropping of radio messages on wavelengths operated by police forces and security organisations must be prevented. User-friendly scrambling facilities should be integrated in the radio system.

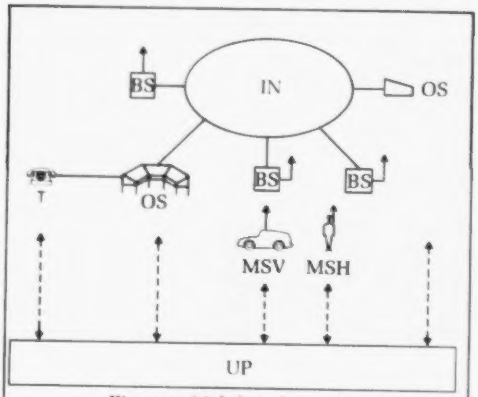


Figure 1: Mobile radio system

BS	– Base station
IN	– Interconnection network
MSH	– Mobile station, hand-held
MSV	– Mobile station in vehicle
OS	– Operator station
T	– Telephone network
UP	– User's process

Figure 1 shows how a mobile radio system is set up. The network IN interconnects the base stations and the operator stations, with either wire or radio links used for the transmissions between them. The operator stations OS also act as exchanges for connecting the private radio system to the public telephone network. The links to the user's process UP are established by means of the operator stations OS, the mobile stations MSH and MSV, and the telephone network T.

Many modern radio networks have a far more complex infrastructure than the older systems. In the first place, the need to economise on frequencies means that often base stations can no longer be sited at very high, exposed locations, with the result that a large number of stations is needed. Secondly, as users are unlikely to accept poor zone coverage, an even greater concentration of base stations becomes necessary.

Such infrastructures demand comprehensive monitoring and alarm signalling to ensure that disturbances in any area are quickly detected. A remote diagnosis should be accurate enough to allow the maintenance services to schedule their work in accordance with priorities.

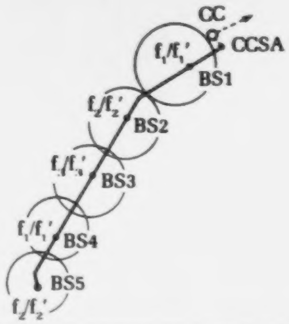
In the simpler systems, the alarms are displayed on a visual display unit (VDU) terminal and logged on a printer. In more ambitious projects with a high-performance computer, the network status is displayed on a colour monitor, thereby providing an overview of the situation at all times.

Public and private telephone networks are other important media used in control, and very often operators of private radio systems require a link between the telephone and radio networks. With large-scale radio systems, and particularly those employing cellular units, communications between the various radio networks must also be possible.

A distinction is made between manual and automatic switching. Manual switching has dominated in the past for no other reason than its technical simplicity. In modern systems with processor-controlled infrastructures and processor-controlled mobile units, operational aspects alone decide which operating mode is preferable.

Figure 2: IPSA network configuration

BS – Base station
CC – Communications centre
CCSA – Communications centre in Saudi Arabia
f/f' – Frequency pair
—— – Fibre optic cable
---- – Four-wire connection



An example of a mobile radio network in operation is the system being used by maintenance crews working along the IPSA oil pipeline between Iraq and Saudi Arabia, who rely heavily on radio communications for instructions and information. These crews work with both portable (hand-held) and mobile radio units, which are mounted in their vehicles. As Figure 2 shows, five base stations are necessary for dependable radio coverage. One channel of the fibre optic cable running parallel to the pipeline can be used as the link between the base stations and the communications centre.

An in-line network with serial receiver diversity is the only practicable network structure which can be considered. Figure 3 shows the basic infrastructure.

With this network, the following operating modes are possible:

- ☐ system in a state of rest, with every base station operating as an autonomous repeater (i.e. up to five mobile-mobile links are possible at the same time).
- ☐ voice transmission between the communications centre and every mobile station, in which case the centre 'occupies' all transmitters and repeater operation is cancelled at all base stations.
- ☐ system switched to form a 'large repeater' covering the whole area. In this mode direct radio communication is possible between mobile stations in different service areas.
- ☐ manual switching (in the communications centre) of radio calls to another communications centre in Saudi Arabia.

An operator's console is employed in the communications centre. Line terminal 1 is connected via a four-wire line to the fibre optic cable leading to the base stations. Line terminal 2 can be used to establish a link with the communications centre in Saudi Arabia.

The operator's console features the following functions:

- ☐ monitoring of all conversations;
- ☐ squelch display;
- ☐ communication with the mobile stations;
- ☐ testing of all transmitters; the receiver with the strongest dial is automatically selected;
- ☐ 'large repeater' mode; with this facility mobile stations operating in different service areas can communicate directly with one another;
- ☐ manual switching of calls to the communications centre in Saudi Arabia;
- ☐ automatic limitation of transmission time.☐

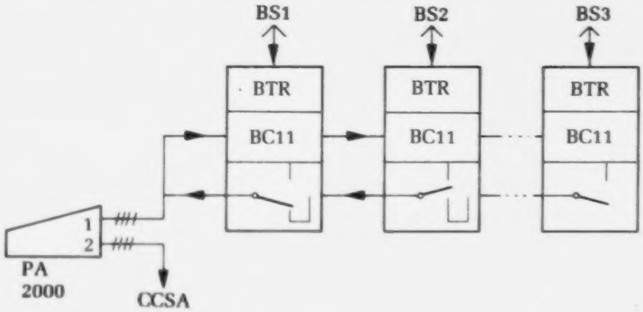
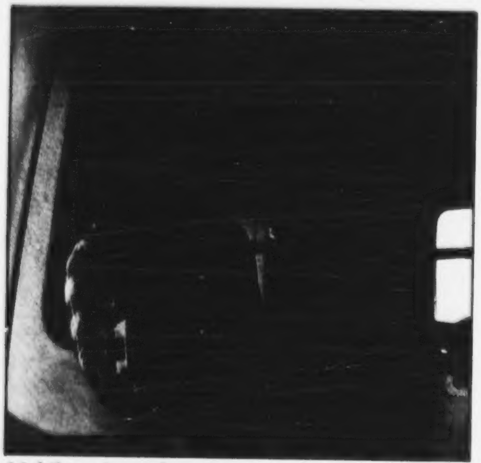


Figure 3: Block diagram of the Infrastructure

BC11 – Base station control unit
BS – Base station
BTR – Transceiver
CCSA – Communications centre in Saudi Arabia
PA2000 – Operator's console

EXTENDING THE SCOPE FOR MOBILE RADIO NETWORKS

Traditional mobile radio systems tend to be hampered by coverage limitations, especially where frequencies are overcrowded. Yet there is clearly a demand for increased voice and data facilities on mobile networks. P J Delow, Technical Manager of GEC Communication Networks Ltd, a Management Company of the UK General Electric Company PLC, describes a shared system, applicable in any location, that overcomes these problems.



Mobile units and customers' fixed terminal equipment fit into the first level of the network architecture.

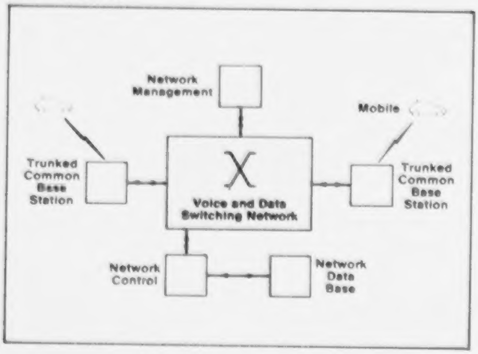

Network Management
Mobile
Trunked Common Base Station
Voice and Data Switching Network
Trunked Common Base Station
Network Control
Network Data Base

Figure 1: Basic network concept for a shared mobile radio network handling voice and data.

IN RECENT years telecommunications users have been increasingly attracted by shared systems, such as common base stations and message handling. Such systems can offer considerable spectrum efficiency improvements over traditional mobile radio systems, particularly if trunking techniques are employed.

The allocated frequency band is used to construct an integrated network which will provide a full range of communications facilities for business and other users. Any limits will probably be set by commercial and regulatory considerations, rather than technical constraints. The following services are envisaged:

Voice services

- ☐ selective, two-party calls;
- ☐ fleet calls (broadcast and group);
- ☐ dispatcher facilities (including queueing and multi-desk working);
- ☐ priority and emergency;
- ☐ unattended mode (storage of call data at the mobile for call-back);
- ☐ PABX incoming and outgoing calls;
- ☐ PSTN outgoing calls – mobile to telephone unit;
- ☐ advice of call transfer;
- ☐ value-added voice services.

Data services

- ☐ status reporting;
- ☐ circuit-switched data (audio band);
- ☐ store-and-forward short data messages;
- ☐ shared data channel;
- ☐ bureau data services;
- ☐ access to public data services;
- ☐ vehicle tracking and security.

This kind of network will overcome the shortcomings of existing shared systems, in particular coverage limitations, and will offer services not currently available. The first system to be provided in the United Kingdom uses the 174 to 225 MHz band (VHF Band III) recently vacated by television monochrome transmissions. However, the concept is equally applicable to other frequency bands.

The system is illustrated in Figure 1. This assumes a selective mobile-to-mobile call, but other classes of call are treated similarly. Mobiles communicate through their respective trunked common base stations, which are interconnected by a voice and data switching network. This allows authorised mobiles to communicate as they roam throughout the combined coverage area of the networked base stations.

Mobiles and network communicate by digital signalling, either on nominated control channels when a call is not in progress, or by blank-and-burst signalling during a call. Each base station has available a pool of frequency pairs which are assigned to calls on demand. Accordingly, mobiles must be frequency-agile (synthesised) over the band used by the network.

A voice and data switching network includes digital voice switches, packet data switches and digital transmission links. Setting up and clearing down of calls within this network is vested in a network control sub-system. This is shown in Figure 1 as a single element, but in the real network a number of processors will be distributed throughout its extent. This control sub-system is assisted by a network database which holds up-to-date information on users, including tracking data to enable the network to locate them easily. The network database is also a distributed sub-system.

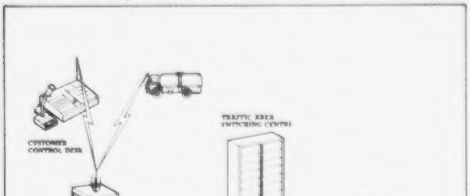


Figure 2: Typical network hierarchy.

Network performance is monitored and optimised by a network management sub-system. This is also responsible for maintaining a central register of users and providing billing information.

The network architecture, arranged in a four-level hierarchy, is illustrated in Figure 2. At the first level are the mobile units and customers' fixed terminal equipment. Base stations, grouped into traffic areas, occupy the second level. All base stations within the same traffic area are connected in a star configuration, to a traffic area switching centre (TASC). This forms the third level in the hierarchy, the highest, at which call set-up operations are carried out.

A network management centre (NMC) occupies the topmost level. This serves to oversee the general system operation, maintain customer records and collate billing and traffic data.

To ensure satisfactory performance users' terminal equipment must be totally compatible with the network. However, it is highly desirable that users should have a choice of equipment, and scope for customisation to suit their own requirements. These can be met by specifying two standard interfaces between the network and users' equipment: the air interface and the line interface.

The air interface will provide a standard for units which use the allocated frequency band as their means of interconnection with the network. This will encompass all mobile units and some 'fixed mobile' control units. Many users will find that their communications requirements will be best satisfied by a direct line connection from their office, control centre or PABX into the network.

The line interface is a line terminating unit, which can be a fairly standard piece of equipment regardless of any customisation required to meet special user requirements. These may be met by additional equipment designed individually.

A nationwide mobile radio network of the type described allows much more efficient use of frequency allocation at a time when the extensive use of mobile radio in highly industrialised countries has led to severe frequency overcrowding. Such networks have major applications worldwide, in both metropolitan and rural areas. They can offer the user a far lower per-user cost than traditional systems, nationwide coverage and the capacity to handle voice and data with equal ease. ☐

Export program

Band I to III and IV to V TV transmitters, TV studio equipment. Medium-wave and long-wave radio transmitters, radio stations, dispatcher VHF radio networks. Transmitting tubes, power klystrons for TV transmitters, pickup tubes, microwave tubes, [illegible] lasers. Studio sound equipment: broadcasting studio equipment, consoles, outside [illegible] vans. Multiplex transmission systems FDM and PCM systems, special measuring instruments for multiplex systems, equipment for load dispatching offices in power systems. Public exchanges and nodal switching centres, exchange components, standard and electronic private branch exchanges.

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For many years, Centro has been a leading integrator of fixed facilities and the number one builder of mobile broadcast and production vehicles (OB). These have bridged every functional requirement from small ENG/EFP (Electronic News Gathering/Electronic Field Production) vans to complete mobile broadcast facilities. Each one incorporates Centro's ability to accurately assess the needs of each client, designing, engineering, and fabricating vehicles to meet today's needs with sufficient flexibility to meet the needs of tomorrow. Your first meeting with Centro's project management team gives you a sense of comfort. As your new mobile unit moves from renderings, blue prints and highly detailed CAD/CAM drawings to fully integrated systems, the accuracy of your first impression will become readily apparent.

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So it should come as no surprise to find out that the most rugged, most versatile, most valued SNV on the market comes from Centro. Why not take a minute right now, while you're thinking about it, and give us a call. Before the next big story breaks and they're on the air again, first.

Centro is a subsidiary of Skaggs
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The Unlimited World Of Paging Systems

By Bill Hollins — Marketing Director of Multitone Communication Systems Ltd

MULTITONE's development of the world's first radio paging system in 1956 for St Thomas', one of London's largest hospitals, was the beginning of a new era in communications. The management at St Thomas' had recognised the need for a reliable means of alerting their medical staff, without disturbing their patients, and Multitone provided them with the answer. Prior to this there was no discreet method of contacting personnel on the move, either within a building or on a large site.

In the 30 years since its invention, radio paging has seen many exciting technological developments and Multitone has been a major force behind these advancements. The company has invested considerable financial and personnel resources in research and development, with the firm intention of maintaining its role as world leader in the field of radio paging. It also pursues the policy of ensuring that the individual needs of a particular customer are fulfilled, wherever possible. As a result, Multitone's products are capable of adapting to innumerable paging applications.

Applications

Following the worldwide acceptance of paging in hospitals, many other kinds of organisations recognised that Multitone could also offer them a more efficient and cost-effective means of contacting their staff on the move.

Today, Multitone radio pagers can be found almost everywhere — from systems in hospitals which help to save lives, to those which monitor dangerous equipment in factories, where a pager automatically receives an alert if a vital piece of machinery fails, or temperatures rise above the prescribed danger level. Firemen and coastguards throughout the world rely on Multitone pagers, as do lifeguards at public swimming pools, educational establishments, hotels, restaurants and shops, airports, seaports and oil refineries. Many of the applications are unique, with systems designed to solve a specific problem, or adapted to suit a particular environment.

On-site Paging

On-site paging systems are privately owned and operated and, although they may be restricted by national regulations to the boundaries of a particular site, they can be used to cover considerable distances.

In the last decade, 'off the shelf' on-site paging systems (transcoders) have been available which provide extremely cost-effective communications for the small to medium-size company. They require no installation — the control unit simply plugs into the nearest electrical power point — and the most recent of them, Access 340, offers telephone coupling to any compatible telephone system enabling individuals to be paged from any telephone on the premises, removing the need to call the telephonist first, therefore saving both time and money.

An example of on-site paging covering a large area is at Gatwick Airport in the UK, the world's third largest international airport, handling 17 million passengers a year, where the receivers have a tone alert and the choice of digital or voice messages, with talk back facility in some cases.

It is used by maintenance staff throughout the passenger terminal and three departure and arrival piers and is linked directly to the telephone network. Contact is made by simply picking up a telephone anywhere in the airport and dialling a few digits. The calling telephone extension is identified on the receiving pager's digital display and a verbal message can be transmitted. All supervisors have two-way voice paging transceivers enabling them to respond immediately by radio, rather than by telephone, which gives much faster communication. The fact that these transceivers offered the best voice reproduction was a major reason for the management at Gatwick choosing Multitone. The lower cost and lighter weight of pagers, as opposed to two-way radio or cellular telephones, were two other benefits that influenced their decision.

Private Wide-Area Systems

Private wide-area systems differ from on-site insomuch as they are engineered to extend the range of paging to cover up to approximately a 15 mile radius. Such systems have been installed in oil refineries, nuclear power stations and for engineering staff in major cities and rural environments.

A typical example is the Shell refinery just south of Liverpool in the UK where Multitone's intrinsically safe digital pagers (which have been approved by the European authority, CENELEC, for use in hazardous areas) are used to avoid any risk of explosion. The site covers over 1,000 hectares and, prior to installation, mobile staff were difficult to contact most of the time. Now, with an impressive range of several miles even the most elusive member of staff is within reach.

Along the Arabian Gulf coastline of Abu Dhabi, at Ruwais, Multitone paging has been installed at the natural gas fractionation complex and, deep in the Abu Dhabi desert, an oil extraction plant at Bu Hasa also uses a private wide area system supplied by Multitone.

International airports are also regular users of private wide-area paging. At King Khalid International in Riyadh, Saudi Arabia, over 250 Multitone pagers are used by administrative staff. Queen Alia International in Jordan, Doha airport in Qatar, Carthage airport in Tunis, and Schipol in Amsterdam, Holland are just a few of the many airports using Multitone paging equipment around the world.

Wide Area Paging

National radio paging systems, operated by PTTs, use Multitone equipment. In the UK, British Telecom operates a system which gives nationwide coverage. Multitone supplies BT with the highest percentage of their tone-only pagers and also supplies alpha-numeric pagers.

The whole of Dubai, an area of 390,000 hectares, is covered by Multitone paging which is used by the municipal authorities. In the American Hospital in Beirut there is a totally independent Multitone paging system, i.e. it is not telephone linked, which is a particular advantage in a city where telephone wires are often down. In El Salvador, again, Multitone paging is used as an independent means of communication — a life saver during the recent earthquake which made the telephone lines inoperable.

In Russia, where the word for pager is 'Multitone', a system was installed in the summer of 1979 for use during the Moscow Olympic Games and has worked continuously ever since to provide city-wide coverage, with a range of 60 kilometres from the city centre. Approaching 4,000 subscribers from various state organisations such as ambulance drivers, senior medical staff and broadcasting media personnel use tone and numeric display pagers.

In Qatar, Multitone's distributors, Business Communications Qatar (BCQ) operate a wide area system for the capital city of Doha with a facility known as 'bleep control' whereby wearers of pagers can be contacted 24 hours a day. Amongst the users is the British consul who is often required urgently to give assistance to British nationals.

In October 1986, Multitone secured a contract for wide area paging from the Taiwan PTT to cover the whole of the island with more than 20,000 tone and display pagers being supplied initially.

Paging Links

Recent advances by Multitone include the development of the Access 3000 and 7000 paging terminals. The key feature of the latest systems is modularity, which means that they can be expanded easily and customers can choose a system with the facilities they currently require, knowing they can expand and develop their system as their company expands, without the worry of obsolescence.

Whilst advancing technology means that most modern paging systems are telephone coupled, Multitone has not lost sight of the fact that there is still a requirement for a totally independent system — one which does not rely on another communication system in order to operate. This is particularly important in the developing world where on average there are only three telephones for every 100 inhabitants, compared with one to every two inhabitants in the industrial nations. Paging systems, often the plug-in variety, are the ideal answer in this case. A small control unit, no bigger than the average telephone, sits easily on a desk and is operated by one person who requires minimal training.

For situations where there is limited telephone access, or simply no telephones, Multitone will supply an intercom system which can be interfaced to paging by adding a special unit as one would add another station. Once this is installed, paging calls can be made from any of the intercom stations on the system.

Future Developments

Communications technology is currently advancing at an encouraging rate. It is believed that the use of on-site paging will continue to grow steadily in developed markets and will grow dramatically in the developing ones. Wide area paging will grow substantially worldwide, matching the already deep market penetration in countries such as the USA. Similarly, companies offering wide area service to the public will multiply and, with the resultant increased competition, paging will become even more cost-effective.

Although the cellular telephone and two way radio are alternatives when two-way speech is required, lower cost and smaller size are the advantages offered by pagers over them. It is true that they are now portable, but none clip easily on to a belt or slip unobtrusively into the average shirt pocket. By offering a flexible, easily adaptable and cost-effective communications package, radio paging will continue to be chosen by a rapidly increasing number of establishments in a wider range of markets. □

Mini-pagers

Apart from being a bit thicker, our RPR 300 pager is no larger than a credit card!

It has four different bleep codes — each representing different messages. And if the carrier doesn't want to be distracted calls can be stored in the pager's memory.
A system can have from one up to 100 pagers and calls can be made selectively to any one of them or to a group.

Versatile pagers

Our RPR 330 series of pagers offer both tone alert and digital display plus speech.

There is a message storage capability, a group alert facility and a vibrator for paging in noisy or confidential environments.

Number pagers

The RPR 322 pager can alert the wearer with up to four different bleep patterns and then display a message up to 24 characters in length.

Its memory will store up to six different messages and it also has a vibrator option, an extended alert option and a display backlight for night-time use.

multitone

Word and number pagers

The RPR 352 pager can receive messages that are up to 500 characters long. These can be scrolled forwards or backwards on a large display panel holding up to 16 characters. It has a flexible alerting system and four function codes that can work as tone alone, or send word or number messages.

Pagephones

When two-way speech is required nothing compares with our Pagephone. It is a high performance, high quality transceiver with three position volume control and immediate direct two-way communication. It can also receive number or word code messages and can store messages for later review.

To sum up, we at Multitone can provide an amazingly wide range of pagers and paging systems. And, with our unrivalled experience, we naturally help our customers to decide which system is best for their particular requirements.

Doctors, nurses, oilmen, firemen, engineers, executives, lifeguards, coastguards, shopkeepers, museum keepers and countless other people in all walks of life already depend on Multitone.

Over the last 30 years it has been our policy to invest considerable financial and personal resources in research and development.

As a result we are constantly improving our systems and we are determined to maintain our role as world leaders in the field of radio paging.

For more information please contact us at the following address:

Miss J. Roberts, Multitone Communications International, 12 Underwood Street, London N1 7JT, England, Tel: 01-253 7611. Telex 266518.

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WE'VE GOT THE SYSTEM

For dependable land mobile communications.

Uni-Lab provides systems for
- Paging • Links • Trunking Systems
- Subscriber Links • Mobile Radios
- Control Consoles

Police Security & Military
The highest quality communications equipment is mandatory for reliable operations. The KU series not only offers reliability but ease of installation and servicing with reduced down time.

SSB UL324B Left

The Concept

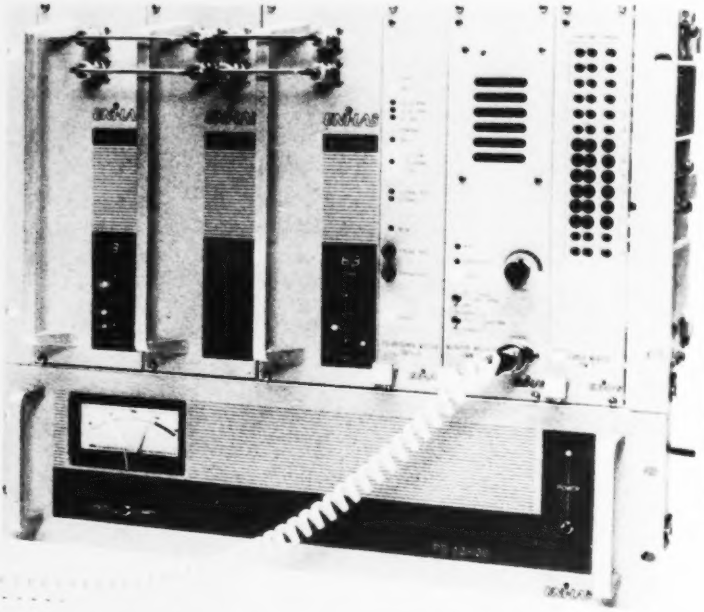
The UNI-LAB KU Series Modular VHF/UHF basestation was designed and built by Engineers who have had considerable practical experience in the installation and maintenance of complex communications systems.

The KU Series not only offers the modular concept but also a unique redundancy feature. By designing a common transmit/receiver module, redundancy is built in. That is, use one module as a repeater transmitter and another identical module as the receiver and you have a spare in each. Simply swap modules and the spare is brought into service.

UNI-LAB offers a large range of options modules which can be configured to form basic or sophisticated basestation and repeater systems.

Options:

- *50-200 watt PA Modules*
- *CTCSS and 5 to 32 Tone Sequential Signalling*
- *Voice Plus Data Branching*
- *Full Duplication Changeover Modules*
- *Directional Couplers and Turn-around Mixers*
- *Diplexer Modules*
- *Auto Testing and Supervisory Modules*
- *Technician Access & Monitor Modules*
- *Patching/Jackfield Modules*
- *Community Repeater Modules*
- *Line Interface Modules*
- *Paging Interface & Control*
- *Active Hybrids*
- *VF and Logic Matrix Modules*
- *Fan Cooling Modules (for 100-200W PA's)*
- *Full range of Mains Power Supplies*
- *d.c.-d.c. Converters*



UNI-LAB TELECO

The KU T/R Module

The heart of UNI-LAB's KU Series is the KU T/R module, supplied in all bands from 66MHz-520MHz. The KU module has two distinct roles.

TRANSMITTER, with 64 channel switching capacity, fully synthesised with output power adjustable from 1 to 50 watts. The direct F.M., linear transmitter lends itself well to Paging and Data options.

RECEIVER, with 64 channels and synthesised. This receiver will outperform most in all areas.

Other KU Series Modules

UNI-LAB have developed a number of modules which work with the KU T/R module to perform many functions. These modules plug into a pre-wired subframe alongside the KU T/R. Rear backplanes can be wire wrapped. All features can be field configured. This feature alone will win the hearts of hardened installation staff. Ask to see UNI-LAB's comprehensive data sheets for your application.

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SSB UL324B Right

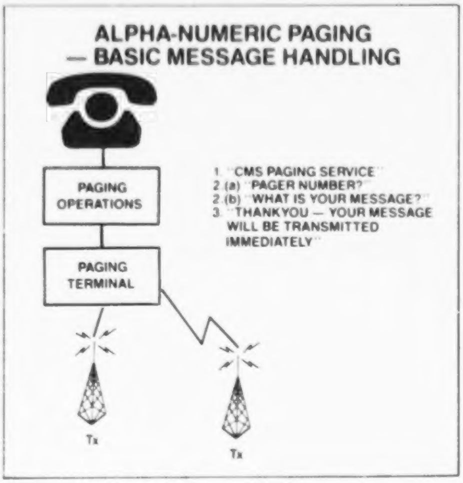
A PAGING SYSTEM THAT IS MORE THAN "BEEP-BEEP-BEEP"

With the introduction some 3 years ago of the Digital Display Pager, an Australian Company, CMS Business Systems International Pty Ltd, (CMS), developed a number of hardware and software packages which enhanced the role of a Radio Common Carrier (RCC) from being merely a way of transmitting messages to being a sophisticated, yet cost efficient, way of collecting and transmitting small packages of information for subscribers.

Besides supporting the traditional paging functions using a tone only pager, the CMS system significantly enhances the operation of the display pager (especially the newer alpha-numeric pagers), as it takes advantage of this latest state-of-the-art technology. These advantages encourage immediate subscriber acceptance of this new paging technology and minimise confusion by transmitting to the subscriber sufficient information to allow him to determine the degree of urgency and thus take appropriate action without the subscriber having to call back to obtain this information. The integration of an Automatic Call Distribution (ACD) switch within the CMS system allows for the provision of a personalised answering service (an enhanced Telephone Answering Service) as well as other value added paging services.

Traditionally, paging operations for RCC have ignored the role of the alpha-numeric messages as most RCCs did not have available alpha-numeric pagers until a few years ago. Thus paging terminals and networks were designed mainly for Tone Only pagers. To overcome this limitation, RCCs have often resorted to adding mini-computers to handle this new traffic. CMS however, took the decision some years ago to use micro-computers for this task so as to reduce the cost of hardware and take advantage of the fastest growing technology sector within the computer industry. Thus CMS began by using a micro-computer based on the 68000 Motorola chip and now is using ALTOS 3068 which used the 68020 Motorola chip.

The use of a multi-user micro-computer allowed CMS to provide a very cost effective solution to the paging market. Not only was the cost per port some two to five times lower than the traditional mini-computer port but this allowed the RCC who was using the CMS system to offer computer port connection via traditional telco lines/modems and VDU to do their own paging without interfering with other users or having the cost associated with normal operator assistance for entry of alpha-numeric paging.

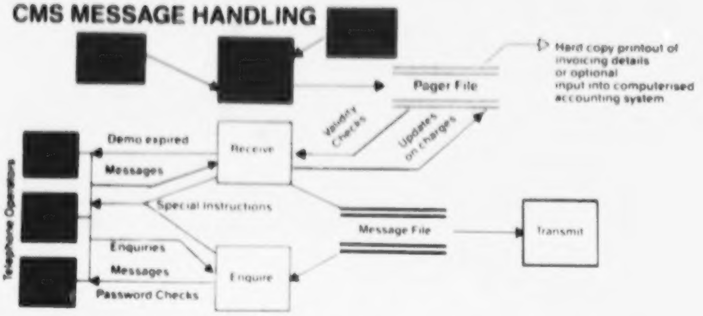

ALPHA-NUMERIC PAGING — BASIC MESSAGE HANDLING
PAGING OPERATIONS
PAGING TERMINAL
1. "CMS PAGING SERVICE"
2.(a) "PAGER NUMBER?"
2.(b) "WHAT IS YOUR MESSAGE?"
3. "THANKYOU — YOUR MESSAGE WILL BE TRANSMITTED IMMEDIATELY"
Tx
Tx

The current Message Handling Software (MHS) is written in COBOL, to allow for ease of maintenance and portability to different computer systems. It currently runs on an ALTOS 3068 micro-computer which can have up to 8Mbytes of memory, 40 user ports, 60Mbytes tape streamer and up to 540Mbyte of disc storage. To ensure high reliability each CMS system usually has two ALTOS 3068 computers with one on-line and the other being the hot stand-by which is constantly updated under software control.

The MHS was developed to link all functions back to the subscriber file, which in turn was interfaced to an on-line accounting package so that no user of the service could get his messages without paying for the service. The subscriber data has over the years grown to provide added functionality to the MHS by providing such features as reminder calls, do not disturb periods, redirection to other paging centres in other cities or provinces as well as repeat messages and hard copy confirmation of all paging calls using remote printers via PSTN and asynchronous modem connection.

As the MHS has grown over the last few years, not only have corporations used VDUs connected via modems to the ALTOS micro-computer, but connection has been established using a CPU to CPU link between their mainframe and the ALTOS. This allows for more efficient use of the central equipment as well as enhancing the use of alpha-numeric paging services by these corporations.

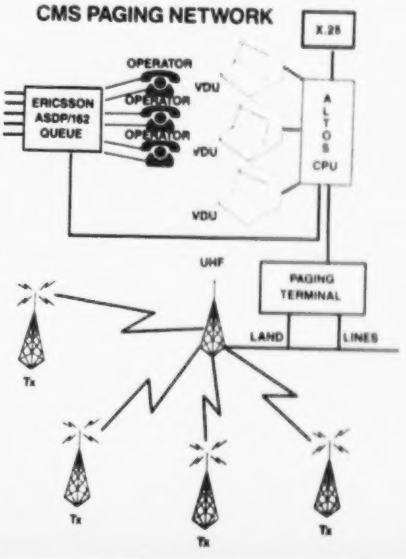
With the need to provide message handling services for the subscriber who travels to areas serviced by other RCCs the Message Handling System was extended to provide interstate links using a CCIT X.25 packet switching system. Thus a subscriber who departs one area has to only call his operator and advise that he will be away for a


CMS MESSAGE HANDLING

Hard copy printout of
invoicing details
or optional
input into computerised
accounting system
Pager File
Validity Checks
Updates on charges
Demo expired
Messages
Receive
Special instructions
Telephone Operators
Message File
Transmit
Enquiries
Messages
Password Checks
Enquire

fixed period of time and, the operator enters this information on her screen after accessing the subscriber's record. Subsequently, all calls received in his area will automatically be transmitted via the X.25 to his new location, received by an ALTOS micro-computer there, and sent to the paging terminal by the Message Handling System.

The logical extension to the service was to integrate the operation of a telephone answering service with the paging service. This enables subscribers to have access to a telephone service which is answered in their own name, as if it were their own office. An operator takes a message or prompts information from the caller, following directions displayed on a VDU, and uses the paging service to relay the message or information to the subscriber. CMS achieved this by developing software for the ALTOS 68020 micro-computer which inter-worked with the software or an LM Ericsson ASDP queue system to provide interconnect facilities for the RCC in respect of Tone Only pagers as well as a sophisticated telephone answering service.


CMS PAGING NETWORK

X.25
OPERATOR
OPERATOR
OPERATOR
VDU
VDU
VDU
ERICSSON
ASDP/162
QUEUE
A
L
T
O
S
CPU
UHF
PAGING
TERMINAL
LAND
LINES
Tx
Tx
Tx
Tx

The development by CMS of a new paging terminal designed specifically to serve the needs of an RCC serving alpha-numeric pagers has greatly enhanced the reliability of the system whilst containing capital expenditure. Encoding and scheduling are processed by an IBM PC and keying-up of the transmitter and generation of tones are handled by a specially designed tone modulator.

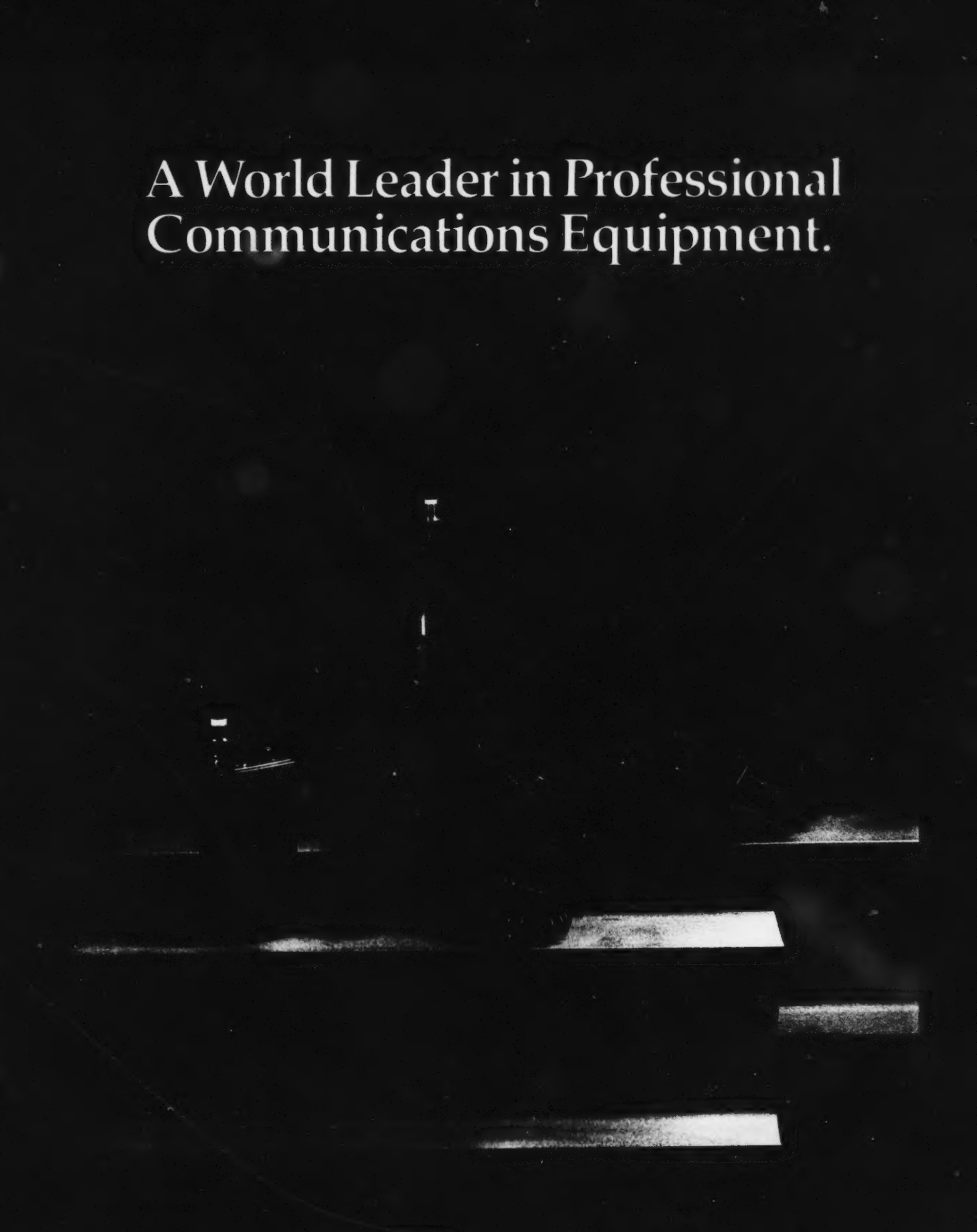
Using a high level language ('C' Language) on the IBM PC to generate the control and conversion algorithm for paging has meant that the paging terminal can readily be changed and enhanced. This approach allows for the development of special codes for paging and/or other applications with minimal effort through the use of floppy disks as the distribution medium.

A sophisticated self checking algorithm in the CMS PT is implemented every five minutes to check its own operation by using a display pager to decode the self test message. The Monitor on the IBM PC continually displays the status of the incoming data, the various queues in memory awaiting batching and transmission as well as the output status of the transmitter modulator as it 'talks' to the paging transmitters.

The network is completed by the provision of the specially developed CMS paging transmitter (CMS XT100). Rated at 100W continuous duty cycle for analogue and digital paging, the transmitter has special control front end circuitry which use an industrial PC with 3.5 inch Floppy Disk to set under software control the AGC, delay and equalisation characteristics as well as dynamically being able to change up to four separate transmitting frequencies. The CMS XT100 also has complete remote diagnostic capability through the use of dial up and auto-answer modem being built into the controlling PC which can report using PSTN or UHF links.

For further information on the latest in paging hardware and software contact:—

CMS Business Systems International Pty. Ltd.
4th Floor, 60 Foveaux Street, SURRY HILLS, N.S.W. 2010, AUSTRALIA.
Telephone 61-2-281-1666 Fax 61-2-281-1940


A World Leader in Professional Communications Equipment.

Maxon Builds Business Worldwide by Providing Reliable Products, Economical Pricing and Responsive Sales Service

by H.L. Bowman, *Managing Director, Maxon Electronics Middle East Ltd.*

Headquartered in Kansas City, Missouri, USA — and with sales offices in London, Athens, Hong Kong, and Seoul — Maxon Electronics has made its impact on the world electronic communications market. Begun in 1972, Maxon has already established itself as the "Number One" supplier of portable two-way radios to the commercial markets of the United States and the United Kingdom.

Supported by the quick responsiveness of these five strategic marketing offices, Maxon Electronics offers its international clientele a complete line of two-ways — including "lightweight" and "heavy duty" portables and a rugged slim-profile mobile unit. Both VHF (66-88 MHz or 136-174 MHz frequency bands) and UHF (450-470 MHz frequency band) models are available.

Compact 2-Way FM Portable Radio

Maxon's 5-watt/4-channel hand held delivers rugged performance and exceptional value in a very compact and lightweight communications package. With such features as the rugged, heat-resistant Noryl-190® case, a die-cast reinforced control deck, and a durable FR-4 glass epoxy circuit board, this Maxon two-way has proven itself on-the-job... under the toughest conditions... around the world. This unit also sports a rugged metal BNC connector and machined aluminum control knobs. The "CS" models feature a battery saving Hi-Lo power switch that permits the user to choose full 5-watt or 1-watt output. Each low cost unit comes complete with one set of crystals, a 500 mAh rechargeable battery, a flexible antenna, wall-mount charger, a stainless steel belt clip and a soft protective case. DTMF Encoding and numerous tone options are available.

Heavy Duty 2-Way FM Portable Radio

The 5-watt/4-channel "HD" is one of most durable portables on the market, yet is one of the lowest in cost. This compact radio features a die-cast aluminum "H" frame, a tough, heat-resistant Noryl-190® case, metal control knobs, and the highest quality flexible antenna. Inside, advanced micro-circuitry on a glass epoxy G-10 board and a long-life 500 mAh rechargeable battery assure long, reliable performance. The "HD" also has the most versatile list of accessories available — including speaker mics, hands-free VOX headsets, and tone signaling options. "HD" models meet U.S. Government Military Specification 810D and are optionally available as INTRINSICALLY SAFE for Class I, II and III, Divisions 1 and 2, Groups A through G.

Slim-Profile 2-Way FM Mobile Radio

With its rugged steel cabinetry, Maxon's mobile two-way is only 1¾" high — allowing for ample leg room even in subcompact cars or trucks. This radio is available as a 35-watt VHF or 30-watt UHF unit. Both the 35-watt VHF and the 30-watt UHF mobiles utilize advanced broad band strip technology to minimize undesirable emissions and achieve excellent spectral purity. Both feature an FR-4 through hole plated circuit board, solid state switching, six-foot neoprene mic cord with metal connector, hinged PA deck, and four tone control options. Also included is a heavy duty, adjustable mounting bracket. The faceplate, microphone and optional auxiliary speaker are all made of tough, heat-resistant Noryl-190®. Other options include a heavy duty 10 amp power supply for base station use and a noise cancelling mobile microphone.

maxon

FOR MORE INFORMATION CONTACT
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TELEX: [illegible]
TELEPHONE: [illegible]

NMT MOBILE TELEPHONE SYSTEM PROVES SUCCESSFUL IN TURKEY

The Turkish NMT cellular radio telephone system was opened on October 22nd, 1986. On its inauguration it covered the Ankara and Istanbul city areas. By the end of last year the network offered its services on a regular basis to 400 subscribers. By early May the system will be able to service 6000 subscribers.

The system has turned out a great success in Turkey. Thus the Turkish PTT and Nokia-Mobira, the supplier and designer of the system, are negotiating about a system expansion which would include the road between Ankara and Istanbul as well as the southern coastline city areas in the service of the cellular NMT mobile telephone system.

NMT's increasing in popularity

The system concept of the Turkish network is based on NMT, the Nordic Mobile Telephone System, named after its first application case. It was developed in the early 70's jointly by the Nordic manufacturers, one of which was the Finnish Nokia-Mobira, supplier of the Turkish system. The original system operates on the 450 MHz band and has become the most widely used standard in the world.

Naturally the four Nordic countries were the first to take the new mobile telephone system into use. However, also countries like the Benelux countries, Spain, Austria, Yugoslavia, Algeria, Morocco, Saudi-Arabia, Thailand, Malaysia and Indonesia have adopted the NMT system. One interesting reference case is the People's Republic of China where some parts are covered by the NMT.

Currently the number of NMT subscribers in the Nordic countries exceeds 300.000. As the use of the system grew in popularity the 450 MHb band became overcrowded by heavy use. Thus the system was expanded to the 900 MHz band. This new system is already in use in the Nordic countries and the decision on its adoption has also been made in Switzerland, the Netherlands and Malaysia.

Scandinavian experiences useful in Turkey

The Turkish system has made use of the experience the Scandinavian countries have had of their practically identical system. This way it has been ensured that the Turkish subscribers will have the most advanced services available to them. As an example of this, Nokia-Mobira has applied some of the advanced features of the NMT 900 to improve the operation of the 450 MHz band.

The best possible speech quality and grade of service were the aims in creating the Turkish system. The means to this were the utilization of optimum network configuration at each stage of network expansion. At the initial stage high power stations and tall antennas are used. Later the expansion will rely on the small cells within the wide coverage umbrella stations.

The umbrella network configuration has been used in Ankara and in Istanbul. At the first stage Ankara's capacity will be 2000 and Istanbul's 4000 subscribers. Soon, however, the total system capacity will reach 60–70.000. The system provides the possibility of taking into use a portable mobile telephones.

The system is equipped with a DX 200 digital mobile telephone exhange in Ankara and in Istanbul. Both analog and digital transmission is used to interface the radio base stations to MTX's. The equipment developed for the Turkish system is based on the successful Mobira Talkman concept developed by Nokia-Mobira.

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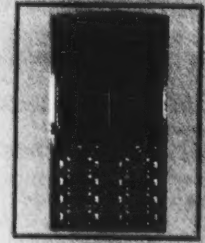
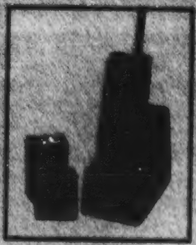
THE ANSWER IS

NOKIA MOBIRA

THE NAME OF THE FUTURE





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H F COMMUNICATIONS ITS VITAL ROLE IN THE DEVELOPING WORLD

In many areas of the world today, including the greater part of Africa, large areas of Asia and South America with no developed and comprehensive telephone infrastructure, it is necessary to find a cost effective and technically viable alternative means of communicating on a countrywide basis. Thinly populated desert countries such as Sudan and Mauritania and the remote bush areas of Uganda and Tanzania have to find an appropriate alternative to the expensive wireline communication networks their economies cannot afford.

One solution adopted by a growing number of organisations is to use high frequency (HF) single sideband radio networks to link their centres of operation on a regional basis. The advantages of HF, in terms of relative simplicity and low cost are significant.

- **Communications can be extended from the city to the remotest areas.**
- **Efficient mobile communication over many hundreds of miles is easily attainable.**
- **Differing levels of technology sophistication appropriate to the needs and budget of each user are readily available.**

However the growth of HF as an accepted and acceptable technology for the nineteen eighties was by no means inevitable. In the early 1970's satellite communications was seen as being the key to opening up and linking whole continents. The early years of the present decade saw the introduction in Scandinavia and the United States of sophisticated cellular radio networks.

HF/SSB technology itself has and is continuing to progress together with other communications technologies. Frequency synthesis, data, facsimile and adaptive frequency management systems are available for military and high grade commercial service. However, the many non-military, non-government organisations, who will not have the budgets to purchase, nor the on-board technical resources to maintain equipment of such complexity must seek a simpler and more cost-effective solution to their needs.

Thus whilst the new technologies have had a major effect on the many countries in the developed world, they have not always matched the needs, geographies, population patterns and economics of peoples in the less developed countries.

And the needs are different. Sudan for instance has an area of one million square miles and a population of seventeen and a half million. Few natural resources, famine, drought, and a traditional way of life, do not call for nor can afford a comprehensive countrywide telephone system. What is required, by specific organisations such as government departments, relief agencies, medical teams, construction companies and others, is a means of linking by voice or teleprinter their main centres of operation in Khartoum, for instance, with the various inaccessible regions in which they are active, often many hundreds of kilometres away across the desert.

High frequency radio however, that workhorse of the 1950's and 1960's, due to be shelved as outmoded and too inefficient for the large network requirements of the 1980's, still has a relevance to this need, and to many others in the third world.

A centrally located HF Single Sideband base station transceiver operating in the 2 to 16 MHz band with a transmitter output power of 150 watts, and using a simple wire dipole antenna can provide efficient and reliable countrywide coverage to other similarly equipped regional stations in the network. In areas where AC mains supplies are not available or are unreliable solar panel technology is available as an alternative and reliable supply source. Mobile operation and communication, benefit from today's reduced equipment dimensions and extended control systems; together with such innovations as noise blanking circuits to reduce the ignition interference.

For the more advanced radio teleprinter requirements the cost and size of error-correcting modems has reduced dramatically in recent years.

A UK company, **AEL Communications Limited** has been one of the leading suppliers and manufacturers of HF single sideband equipment for nearly two decades. Recognising the application of low cost but rugged transceiver equipment to the needs of developing countries, **AEL** has specialised in providing both equipment and product support services.

The four channel crystal controlled **AEL 3030** 150 watt HF/SSB transceiver, of which over 7,000 are in service, has been used extensively to equip a diverse variety of projects; an inter-island police network in the West Indies, road construction projects in Saudi Arabia and Tanzania, a World Health Organisation network in Burkina Faso, a cement manufacturing company in India, and a countrywide aid network in Sudan are typical examples.

Appropriate technology, **AEL** believes, has been the key to the wide acceptance of this particular transceiver:- simplicity of operation with only five essential controls, and ease of maintenance because of the field replaceable plug-in modular design, have been two major benefits to user organisations where local skills and experience are limited.

Other facilities available with the **AEL 3030** include selective calling and radio teleprinter options, solar power systems, and a comprehensive range of ancillaries to provide a full system capability.

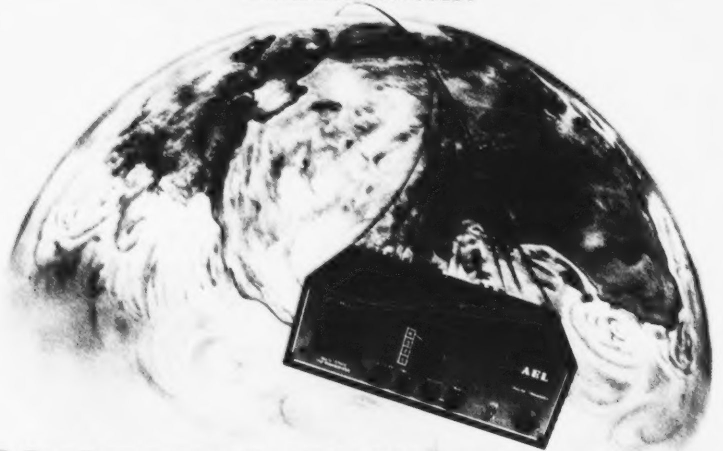
AEL has recently introduced the **AEL 3030 COMPAC**. This low cost, fast delivery system incorporates transceiver, microphone broadband antenna and sectional antenna mast in a standard package, to meet the requirements of aid and relief organisations where rapid deployment is essential.

Thus, whilst the future of much of the developing world is as ever uncertain, the continuing role of HF communications as a low cost, simple mode of medium and long range communication is as vital as ever before.

AEL

ANNOUNCES A RAPID RESPONSE TO YOUR COMMUNICATION NEEDS

THE AEL 3030 COMPAC IS A STANDARDISED HF/SSB COMMUNICATIONS PACKAGE DESIGNED TO MEET THE SPECIALISED NEEDS OF AID AGENCIES AND RELIEF ORGANISATIONS.



- ***Easy Procurement:*** *The AEL COMPAC is supplied as a standard kit at a fixed FOB price.*
- ***Quick Delivery:*** *The AEL COMPAC is dispatched from stock within 7 days of order.*
- ***Rapid Deployment:*** *The AEL COMPAC is lightweight, field expedient and requires no specialist skills to commission or maintain.*

THE AEL 3030 COMPAC INCLUDES

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40 years on the air

From Crystal Sets to Micro-chips

In 1947, a young engineer had a bright idea. He had been fascinated with electronics since he was a boy, and like many of his generation, he started by building a crystal set. In 1987 that sounds quaint and old-fashioned. We are used to supersonic transport and direct communication from the moon and beyond — crystal clear communication. That young man was part of the incredible development from crystal sets to micro-chips. His name is Erik Petersen. His bright idea was to found a company that was to put communications in the hands of everybody who needed it. A company that was to become one of the leading producers of car telephones in Europe, and the best communications systems in the world — Storno.

In fact the history of the company goes back to the last century and to some of the most important communications pioneering the world has seen. Storno started as a daughter company of a concern that laid communications lines under the North Sea, and across the vast plains of Russia alongside the trans-Siberian railway. That concern was The Great Northern Telegraph Company, known more often by its short form, The Great Northern, or in Danish, Store Nordiske. And from that name emerged Storno.

Today Storno has the most modern factories of communications equipment in Europe. Based in Copenhagen, it has daughter companies in France, West Germany, Sweden, Norway and the UK. It has agents in 80 countries spread across the globe. It has a staff of 2,000 skilled and dedicated people. And it is people that have been the greatest single factor throughout the history of the company. In the first five years, they built under 400 radios a year. In 1987 they build 400 a day. In 1947, turnover was about Dkr. 100,000, in 1987, well over Dkr. 1 billion.

But Storno is more than mere radios. What puts Storno ahead of the field is their ability to create systems. Systems large and small, complex and simple — but all with one thing in common. They are designed for, and together with, the individual customer who ordered them.

Systematic Communications

The range of radios and radio systems can seem bewildering. They vary not only from manufacturer to manufacturer but from country to country. Whatever your needs, wherever you may be in the world, Storno can help you bridge the communications gap. In fact, Storno does not design radio communications systems for their customers but with their customers. It is the only sensible way to make sure that a customer gets what he needs — not what a manufacturer wants to sell.

Storno produce radios and systems for countries all over the world. At radio factories in Denmark and Germany, and in dedicated systems factories in the same two countries as well as in France and the UK. The factory in Flensburg, just across the Danish border in West Germany is the most modern in Europe. It houses examples of the machines that represent the acme of automatic production technology — a Surface Mounted Device Assembler. Each machine can mount more than 12,000 components, large and small, on a circuit board every hour, with an accuracy of 0.15mm. Before the finished radios are dispatched, they are subjected to an ageing process — two days in a clima-cabinet at temperatures ranging from −30°C to +80°C. A rational and state-of-the-art factory producing superb products.

Out of these factories come portable radios, mobile radios and fixed base stations. For use in international public nets and national private nets. From the small and simple 4000 series to the Storno flagship, the 6000, meeting all approved signalling systems in the world. We make the base stations to control their activity. And we design and produce the software that makes some of the smallest radios on the market, the most powerful.

But these are just radios. What makes them special is the way they are linked together to form a system. From the smallest of all systems — two people, each with a small, single channel manual radio — to complex multi-channel trunking systems that automatically search for free channels. But complexity does not mean expensive top-of-the-line individual radios. Far from it. What matters is the design that has gone into the systems they are part of. Take for example the 4000 Series of radios. They are simple, user-friendly and affordable hand-held radios. But because of the power and versatility of the rest of the system, having one of these small radios is like having a major metropolitan telephone exchange in your pocket.

From Forestry to Fire Fighting

The range of users of Storno equipment is legion. All of them need fast, efficient and reliable communications systems.

In Algeria, a project was set up with the aim of planting new forests and preserving existing ones in remote areas bordering the desert. The communications need was for links between a large number of control centres and patrol units, and from centre to centre. In the Algerian climate, the threat of forest fires is a formidable one. Communications must be fast. The cost of establishing conventional telephone services is prohibitive, and the service it provides is unreliable. So a central radio command unit was established.

Storno analysed the need and came up with the answer — a nationwide radio system with base stations in the control centres, all linked to a central command centre. Speed of reaction in fire fighting is paramount, so portable radios were the obvious choice, allowing staff to remain in contact even when they have left their vehicle. The command centre can function as it should, by having the flexibility to transfer units from one area to another where and when they are needed.

As well as fulfilling the needs of urgent communications, the network has replaced conventional land line telephones in the remote areas, making for much easier administration.

That the solution to the problem was the right one has been proved beyond doubt. The customer, the Algerian Government, came back later and placed a new order for the country's Customs Service.

Systems very similar to this in principle are operated by a large number of police and security agencies, ambulance services and power plants, all over the world. The needs are never quite the same and neither is the system Storno supplies. But the needs are always great and the system always the right one.

Research and Development

With each year that passes, people and organisations are confronted with increasingly complex problems in their communications needs. For Storno to be assured of continuous growth and success, and to remain a world leader in a high-technology business, they must anticipate those needs.

One of the results of that research is a fully automatic radio for closed networks — the Stornophone 6000. The need will continue for people to have direct voice communication with each other, but of increasing importance is data transmission. The Stornophone 6000 can do both.

It is no larger than a standard car radio and weighs only 1.8 kg. Because of software programmes designed to meet the user's specific needs, it has the capacity of a small computer, with enough memory to store 30 tightly spaced A4 pages. It is easily convertible to a transportable, and the alphanumeric display can contain up to 16 characters and can be programmed to display any language.

The 6000 was not developed just to have a new product to sell. It was designed and produced to meet a need that Storno predicted before even the user was aware of it.

Quality

One of the most discussed and defined concepts in manufacturing. What it all really boils down to is keeping the customer satisfied — and there is more to that than assembly line Quality Assurance principles.

The Storno philosophy of quality embraces everyone in the company, no matter what their job. From salesmen to software engineers, from robot operators to roving trouble shooters, from managers in general to general managers. Because all of them are involved in producing the right article, at the right price, in the required time scale to the required quality standards. Quite simply, Storno is in the pursuit of excellence — a quality record that says zero defects. This can only be reached if everyone in the company is aware of the need, and of the problems they are faced with. To this end, the company briefs, trains, encourages and motivates its staff. In short, there is a commitment to quality.

When all is said and done, the customer makes his own choice. Storno is well aware of that. That is the sole reason for the company's efforts in the fields of quality and service.

That is why Storno has been expanding in a growth market for 40 years. Inventing new solutions to old problems, learning from experience gained from tough challenges and refining the ideas and ambitions of a young boy who used to build primitive radios with primitive technology.

In 1947, Storno built the first FM radio telephone in Europe. In 1987, they build the best radio communications systems in the world. □

Storno

Storno. 40 years on the air.

For 40 years, Storno has been a pioneer in radio communications. From the first FM-radio telephones in Europe in 1947, to the best communications systems in the world in 1987.

Our systems are at work all over the world, where ordinary cable telephones cannot do the job. We call it bridging the communications gap.

We can bridge that gap in many ways. From simple two-way radios to more complex and versatile systems. Whatever your requirements, our philosophy is that we should always be able to deliver the best all-round solution.

But having a philosophy is not enough. It has to be followed up – and Storno does just that. By always staying ahead in the race of product development. By marrying know-how with uncompromising demands for quality in design, production and service. But most important of all, by setting ourselves the goal of putting you, the customer, first.

The greatest single factor in achieving that goal is our staff. They are your guarantee for a product that is, quite simply, the right choice.

That choice is yours – and we know it.

We know too, that it is people that make the difference. That is why Storno has been on the air for 40 years.

Storno

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DIGITISATION & INFORMATION TECHNOLOGY

MAKING THE RIGHT CHOICE FOR A DIGITAL FUTURE

by Stewart Muirhead

The range of options available for buyers of automated office networks can be bewildering. Stewart Muirhead, Marketing Support Manager of STC Telecommunications, describes the basic choices on offer.

IT WILL soon be possible to transmit not only voice but data, text, graphics and video over a single network, utilising one user line and the same subscriber number for all facilities. Communications between any two points in the world will be virtually instantaneous.

The first step towards this has already been taken with the development of digital terminals capable of supporting combined services. The next step, and the one which will make convergent technology a reality rather than purely a topic for discussion, will be the implementation of the Integrated Services Digital Network (ISDN), expected in the United Kingdom 1987/88.

Like many other PTTs around the world, British Telecom is in the process of digitising the public network in the UK so that we can realise the full potential of such technology. Completion is some time ahead, however, which means that network transmission speeds have yet to match the capabilities of the digital systems at the terminal end.

Nevertheless, manufacturers' support of ISDN technology means, essentially, that new communications systems coming on to the market comply with the agreed standards. They will, therefore, be able to take the integrated facilities on board as soon as the digital networks go live, thus fulfilling the ultimate dream of the 'Universal Network'.

The once-humble switchboard, then, is seen by many as the hub of the automated office in the future, with developments in digital switching technology for simultaneous voice/data communications being the most significant trend.

In fact, the majority of new telephone systems specified worldwide today are designed around digital technology. Recent system introductions have seen enormous switching capabilities, with the ultimate aim of interlinking microcomputers, telex, facsimile transmission, malfunction workstations and telephones.

Despite such advances in systems development, however, many organisations have yet to be convinced about the efficacy of installing a modern telephone system. Perhaps the very thought of digital technology puts them off; and it has to be admitted that too many systems are so complicated to use that they would frighten anyone who is not numerically attuned. Many people do not have a facility for remembering code numbers, and few systems incorporate clearly labelled function keys or displays which are easy to understand.

In contrast, some suppliers have developed digital key telephone systems which incorporate truly user-friendly access to facilities. Indeed, bearing in mind that the telephone handset remains the primary vehicle via which an organisation conducts its business with the outside world, ease of use must be a prime consideration. The fact that a system is high-tech should not concern the user, other than that it ensures the system is capable of supporting requirements now and in the future.

There is a wide choice of systems available to today's buyers, but perhaps the most significant trend is the growth in smaller electronic switchboards and key telephone systems designed to cater for smaller businesses. There are now around 80 suppliers serving this market in the United Kingdom when there was only a handful before liberalisation of the telecommunications market.

There is no doubt that the abolition of the British Telecom monopoly in 1984 has done wonders for freedom of choice and has encouraged product innovation. On the other hand, it has made purchasing decisions that much harder, particularly for medium-sized organisations which tend to either underestimate their requirements, not allowing for future growth, or go over the top by purchasing systems with so many features that it is unlikely some of them will ever be used.

There are basically two types of system – the PABX (private automatic branch exchange) or the 'switchboard' as most of us know it, and the key telephone system. The difference between the two is subtle yet important and rests essentially on the number of extensions supported and on system control.

A PABX can support hundreds of extensions and is normally controlled centrally by a designated operator. A key system will support up to 60 extensions, but ideally only up to 40, and can be controlled by any or all individuals.

Modern switchboards are more flexible than the old plug-boards because dialling out and call transfer functions no longer have to go through an operator. However, with a PABX, all incoming calls are still routed through an operator, ie calls are held at the switchboard before being put through to individual extensions. For the larger organisation, this ensures maximum control and a consistent image. All the functions are controlled from the central switchboard and individual extensions use either standard telephones or so-called 'feature' phones, if these are deemed appropriate.

With a key system, control is distributed to the extensions so that any individual within the organisation can answer and transfer incoming calls. Each person, therefore, has a special desk-top terminal which not only shows the status of all the different exchange lines but gives each individual direct access to a number of functions such as memory dialling, on-hook dialling, automatic call-back and the ability to check on the importance of another incoming call while putting an existing call on hold.

There are also hybrid systems whereby a designated operator can answer all incoming calls when appropriate, but any extension can act as the master console when the operator is absent. This means that not every person has to have a sophisticated keyphone when a basic telephone terminal would be adequate.

Similarly, greater flexibility may be provided in a large organisation when individual departments have their own key telephone system which can be linked into the central PABX, enabling users to have the best of both worlds.

The major benefit of modern systems, regardless of the type, is flexibility in the short as well as the long-term – something the old-fashioned analogue systems could not provide. For example, while ease and speed of installation are prime attributes, so is the ability to upgrade the system. It is possible to start with, say, a 20-extension system and extend it to a 40-terminal system, without a major upheaval. Additional ports are added two at a time and can be allocated to either direct lines, tie lines or internal extensions according to requirements.

Dozens of facilities can be incorporated into these systems, but this doesn't mean that they have to be made available to everyone in an office regardless of their individual needs. The management has full control, and access from each terminal can be programmed to allow or bar facilities. The organisation can, for example, decide to bar all staff below manager level from making long-distance calls.

Should requirements change, the system can be reprogrammed using a system manager terminal. If people move offices for example, the systems can simply be reprogrammed so that the favoured terminal can be unplugged and taken with the rest of the office equipment to the new office, with no rewiring required.

Another major benefit of modern telephone systems is that they improve efficiency of business communications, cutting down on the waste of time and money spent on unsuccessful call connection.

Features now include on-hook dialling so that users can carry on working until the call is answered; abbreviated dialling or one-button speed dialling of frequently used numbers; call-back, no answer and call-back when free; and save number to redial.

When receiving calls, facilities include call pick-up by any other extension so that phones on an empty desk can be answered; and auto call forwarding to another extension or 'follow me' whereby calls can be programmed to follow a user to another specified extension.

Other features provided by modern electronic switchboards include auto transfer to another designated extension after, say, three rings; group hunting to find the first free extension in a working team; and call waiting indication.

A useful feature is the display of the calling party's ID before pick-up; and if you want to discuss a project with more than one person, conference calling will allow three people to participate in a single telephone call.

In some circumstances, it will still be necessary to provide a shared manager/secretary telephone so that calls can be filtered. A display enables the secretary not only to alert the manager that a call is waiting but enables the manager to advise the secretary that he is free, is busy or wants all calls held.

It has been said that an organisation could save 30 per cent of its telecommunications bills if it installed a call monitoring system. By plugging a printer into the modern telephone system, traffic details can be printed about calls made by every station, the numbers dialled and the time spent on each. All the information can be analysed as required for full management control and cost distribution.

Today's modern telephone systems are thus cost-effective business tools designed to improve communications and enable organisations to gain an edge in an increasingly competitive world. □

INTEGRATING LANS AND PABXs

by David Sellings

Compatibility should always be a high priority in the acquisition of new communications equipment. All too often, the advantages brought by new products are lessened because they cannot interact with other equipment. David Sellings, Marketing Manager of Northern Telecom, explains the merits of combining the functions of two switching systems – the digital private automatic branch exchange and the local area network.

IF THE integrated office remains the long-term goal of communications users and suppliers alike, it is often commented that the ideal of integration is far removed from the reality of the market place. Many organisations have already made significant investments in data and word processing equipment, personal computers (PCs) and feature telephones. Yet these products cannot readily communicate with each other: word processors seldom share text with one another, data equipment rarely interfaces with other devices, PCs usually function as stand alones and telephones generally transmit only voice. Similarly, different departments within these organisations have different requirements: work patterns and connectivity needs vary from location to location and from person to person depending on the function of these individuals.

In recent years, digital private automatic branch exchanges (PABXs) and local area networks (LANs) have assumed increasing importance. Although these technologies are often viewed as competitive, their capabilities can, in fact, be seen as complementary. Indeed, a close examination of these two switching systems illustrates the advantages of an architecture combining their functions.

Essentially, the PABX is based on a star topology with the PABX itself as the hub and the various peripheral devices as its points. In a typical PABX, analogue input is converted to digital form at the peripheral interface. A digital switching network uses a control processor to provide circuit switched connections between any pair of devices, with voice or data switched at a standard rate of 64 kilobits/second (kb/s). By contrast, LANs support the kind of high data rates, typically in excess of 1 megabit/second (mb/s), necessary for distributed processing. LANs have been developed with bus, ring or star topologies.

While the PABX uses a central processor to set up calls, switch calls and control peripheral equipment, most LANs have no central control point, but the various devices contend for the right to transmit data on to the LAN using distributed control algorithms such as token passing or carrier sense multiple access with collision detection (CSMA/CD). While PABXs are circuit switched, LANs are packet switched. When the sender of a message successfully gains access to the LAN, it injects an explicitly addressed packet of data on to the network. When the destination detects a match between its own address and the address of the packet header, it accepts the packet. Packet switching thus eliminates the need to set up continuously connected circuits when transmitting information. Instead, as information becomes available, communications protocols route it to its intended destination without a continuous connection.

Bandwidth limitations

PABX switching architectures require high total bandwidths. For example, a PABX capable of supporting 1,000 simultaneous duplex 64 kb/s connections requires a total switching bandwidth of 128 mb/s. Even though access to the network is channelled into 64 kb/s increments, digital voice, when switched through a PABX, produces continuous traffic in a channel for the duration of the call. Because each call takes up one channel, bandwidth is quickly consumed when many calls go through simultaneously.

Because most LAN applications produce traffic in bursts, the total network bandwidth required for a LAN is normally less than that needed for an equivalent-sized PABX. As an example, typical LANs might have a total traffic carrying capacity ranging between 1 and 10 mb/s, but they also require high instantaneous bandwidth, and, in most LAN architectures, access bandwidth is equivalent to total bandwidth. Similarly, PABXs may claim a total bandwidth of many megabits per second but their instantaneous access bandwidth will always be the bandwidth of their channels.

Both LANs and PABXs have their respective drawbacks. Until recently, a major disadvantage of LANs was that their data rates were too high for transmission over twisted wire pair so that they demanded special wiring such as coaxial cable, shielded twisted pair or fibre optic cable. A major drawback in the star topology of PABXs has traditionally been that equipment failure in the hub resulted in total system breakdown.

Performance comparisons

While LANs can be used to switch voice, they cannot match the voice switching capability of a PABX. Existing LAN network bandwidth is much lower than that of a typical PABX. As a result, the use of packets and distributed access mechanisms in a LAN lead to significant and variable delays in the voice path. Although the delay itself may be negligible, any round trip voice paths will be heard by the speaker as echo. Solutions to these problems are voice compression, silence compression and echo cancellation, but these prove costly and still produce inferior voice quality to that of a digital PABX.

Clearly, any comparison of LAN and PABX characteristics indicates that digital PABXs provide the optimum solution for voice and circuit switched data traffic travelling at speeds of 64 kb/s or less. In contrast, the packet switching capability and high access bandwidth of a LAN can support the burgeoning applications of distributed processing and PC communications.

Integrated concept

Retaining the classical architecture of the circuit switched PABX, it is possible to provide the structures necessary for LAN and distributed processing functions by the addition of packet transport equipment (PTE) together with appropriate interfaces, a transport bus and controller, and new software. In this way upgrading of existing PABXs already in the field can provide the most cost-effective method of deploying new services.

In operation, one or more digital trunk interfaces link the circuit switched network to the PTE. Voice channels link voice lines and trunks to the voice messaging capabilities of the PTE, and provide access to voice/data intelligent terminals connected to the PTE. Data channels link applications on the PTE to terminals and host computers on the circuit switch.

A major architectural enhancement necessary to the traditional PABX design is in the provision of dynamic bandwidth allocation. In this regard, the essential element in the PTE is an integrated fully redundant packet data bus with an available bandwidth of 40 mb/s. This bandwidth can be allocated on demand allowing any media, whether voice, data, text or graphics, to be handled in an integrated fashion.

The transport controller manages asynchronous access to the transport bus and ensures data integrity. Asynchronous data is normally packet switched so that transport bus bandwidth is only required when valid characters are being transmitted. Synchronous data is normally circuit switched, which implies switching in a protocol independent manner. Circuit switching also supports non-packet orientated data, such as facsimile. Circuit switched bandwidth is assigned whenever a signal producer places data in a specific bus cycle. The principle is analogous to a time slot in a classical time division multiplexing (TDM) switch. Time is divided into frames of 125 microseconds and each frame into 640 bus cycles. All data, whether circuit or packet switched, is sent at the rate of one byte per bus cycle.

Synchronous circuit switched data is allocated by assigning a particular bus cycle to the producer of a signal. This cycle repeats once per frame. If the synchronous producer does not have data ready in each bus cycle, it becomes available on demand to packet producers by means of a polling scheme.

Synchronous bus cycles are allocated under software control and any bus cycle can be assigned for synchronous or packet use. The software also allows for typical system configurations. For example, the PTE can be configured for a synchronous capacity of 480 channels at 64 kb/s, with a minimum asynchronous capacity of 10 mb/s.

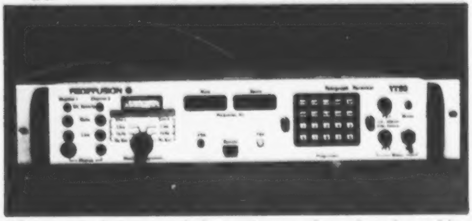
Asynchronous bandwidth is allocated by a polling protocol in the transport controller. The use of a separate polling bus allows 'look ahead' polling to proceed in parallel with data transfer. When granted permission to access the transport bus, an asynchronous packet producer transmits its packet, one byte at a time, in those bus cycles not used by the synchronous producers. Polling is intended to result in good bandwidth utilisation during periods of heavy traffic, and avoids the inefficiency inherent in contention-based arbitration LANs.

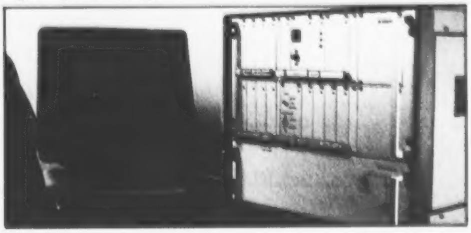
Enhanced communication and connectivity contributes greatly to the decision-making process in the market place. A hybrid LAN/PABX is one way of approaching the present and future needs of the business communicator. Services will continue to evolve in order to augment communication further and, in doing so, improve the effectiveness of individuals and groups within organisations. □

DIGITAL SIGNAL PROCESSING AT WORK IN THE DEVELOPING WORLD

by Carl S den Brinker

Radio systems in remote locations need to be reliable and cost-effective in order to be of any value to a community. Digital signal processing can ensure both these qualities. Carl S den Brinker, Technical Director of Rediffusion Radio Systems Ltd, explains its technical advantages and suggests some possible applications.





***Above:** A slow speed diversity modem developed by Rediffusion Radio Systems in conjunction with the Admiralty Research Establishment in order to counteract either deliberate or accidental interference. **Below:** The TT30, one of a range of voice frequency telegraph terminal units based on digital signal processing.*

COMMUNICATIONS is at the start of a revolutionary upheaval, the outcome of which will be so profound that even those most deeply involved cannot yet fathom its full effect. Both the industrialised and the emerging world could benefit equally from the new technology, although the paths chosen are likely to be very different.

The signals for change became discernible some time ago in the medium of line telecommunications where, in the industrialised world, international and trunk prices have been tumbling in real terms for some two decades now. Greater utilisation of the transmission medium has made this possible.

In radio communications, the first step towards more efficient use of the spectrum has already been taken in that frequency synthesis is now common and, as a result, closer channel spacing has become possible. Users will now wish to exploit their assigned frequency band to its limits and the interaction between computing, sensing and communications technology should provide the solution.

In the industrialised world, the pressure for increased data communication has in many cases been led by defence requirements. Even so, we have seen the introduction of packet switching in the commercial world and even the broadcasting companies in the United Kingdom are offering some of their spare 'haulage capacity' for highly efficient, very cost-effective data transmission systems.

The main feature of data communications is its economy of frequency and time usage compared with audio and video. The reason why we are now at the take-off point is that the semiconductor world has recently become aware that digital signal processing (DSP) can provide them with a new and vast market. This was the last piece in the technological jigsaw puzzle needed to complete the picture.

DSP is now well established, although in general it is still perceived as a methodology for filtering and Fourier analysis. Although it fulfils these tasks with some particularly good attributes, it is capable of far more than that. But our analysis shall begin with a summary of primitive filter characteristics, firstly the difference between the recursive and non recursive topology.

In Figure 1, a single period of a sine wave is shown. At each sampling point the sample is converted into a number which represents the amplitude. Hence we tend to use more bandwidth than is needed in the equivalent analogue system. Say, for example, that we sample a sine wave 20 times as shown in Figure 1 and wish to discriminate signals over a dynamic range of 72 dB. This would mean that an A to D converter of some 12 bits length is needed, i.e. each sample needs a 12 bit number. Each 12 bit number must be multiplied by the sampling rate, which results in a data rate of 12 × 20 = 240 bits per analogue cycle. At first hand this appears to be excessive, but it is a small price to pay for the subsequent advantage.

Each of the numerical samples can be

processed in a purely arithmetic way, and two examples of filter structure are given in Figure 2. It does not take long to appreciate the difference between the two in the case of an impulse response. In the recursive case, the impulse will make its appearance at the output after a delay of θ. After $2 \times \theta$ the output will have fallen to the impulse multiplied by the coefficient to which the filter is programmed. After $3 \times \theta$ the response will be down to (coeff)^2, etc. We have a decaying response. In the non-recursive case, where the coefficients C_1 C_2 C_3 C_4 . . . would tend to follow the pattern of the required response, say sinx/x, the output would be sinx/x. In general, the last version is extensively used where precision filtering is critical.

Figure 1: A single period of a sine wave.

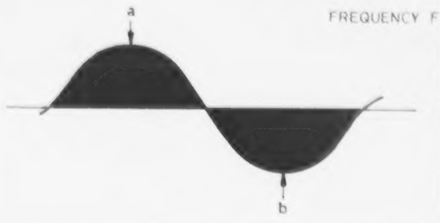


Figure 2: Two examples of filter structure.

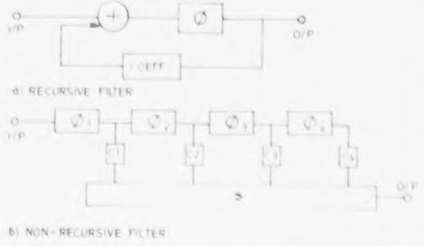
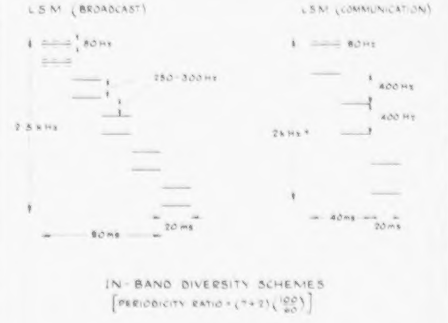


Figure 3: In-band diversity schemes.



The point about digital filters is that their accuracy is determined by that of the A to D converter as well as the clock rate. A to D converters easily maintain their properties and, with crystal clock generators, one need not encounter any drift as experienced in conventional analogue filters. Nor need one worry about temperature coefficients or any of the other conventional sources of error.

But filtering is only part of what DSP does well. Returning to Figure 1, we could think of this as an AM modulated waveform. How could we detect it? In the past we rectified such waveforms with a diode or diode array, but if we could now synchronise a multiplier with the incoming waveform numbers, which would multiply the positive half cycle samples by, say, +1, and the negative half cycle by −1, then we would have a very simple full wave AM detector.

It is a minor step from this stage to determine the peak amplitude (A) and then use the value of A to construct an FM detector. By dividing an arbitrary signal, such as $A \sin wt$, by A, we derive the sine wave without its amplitude component and $\sin wt$ can then easily be differentiated from $\sin (w \pm d)$. So, if one is prepared to pay the price of high data rates, the resultant resolution is significantly more accurate and less prone to temperature or life time drift. So far so good, but we are still talking about a price to be paid and a heavy one at that.

This situation is completely altered if we needed to change frequency rather rapidly. For example, to dart from one frequency to another over a limited range, in order to avoid jamming, the same filter could be used, but with the coefficients altered to suit, thus avoiding the necessity to build a whole series of filters where only one is ever in use at one time.

Applications of DSP technology

It is often the case that defence requirements lead technological innovation which quickly finds a broader application in civilian life. Anti-jamming techniques, for example, are developed for military use to avoid deliberate interference. They are equally applicable to counteracting accidental interference or error caused by ionospheric variations over long distances. In a recent project, some prototype digital modems have been developed which are particularly good at 'ignoring' interference. The principle of the system is illustrated in Figure 3.

The assigned bandwidth is used by spreading sets of tones, each set representing the option of a binary 0 or 1. Then, as shown in this illustration, the symbol is repeated some three times (time diversity) in three different bans (frequency diversity). The system thus has three differing versions in time and frequency of the same signal. With digital signal processing it is now a simple matter to select automatically the two most reliable versions. What is more, by shaping the individual bits in this signal pattern we can concentrate all of the transmitted energy into a very narrow band of frequency. By means of precise signal shaping (described as 'windowing' in DSP language), we give the signal a characteristic nature that is easily recognised in the presence of random noise. None of this was easy to achieve before the advent of DSP. The new technology thus allows us to transmit data reliably at very low power levels, since necessary transmission power is determined by the ease with which a receiver can differentiate legitimate signals from a noisy background.

How, then, can this be of particular relevance to developing countries?

There are many and varied solutions circulating about the problems of the Third World. For example, very polarised views are taken on the subject of food aid versus agricultural aid. None of these, however, deal with the immutable issues of national government.

For any nation to function satisfactorily, its government should be able to respond to the needs of both its urban and its agricultural communities in terms of food, shelter, education, health and the security of law and order. All of these needs require appropriate and reliable communication systems.

The arguments of low versus high technology, which also abound where emerging nations are concerned, are purely academic. A more fruitful approach might be to consider whether examples exist that could be emulated.

The Australasian nations, for instance, contain large urban settlements as well as widely dispersed agricultural communities. Radio communications, locally generated electricity and the liberal use of vertical short take-off and landing aircraft are the ingredients of daily rural life, all of which avoid the need for a massive investment in line telecommunication and major road works. Forest fire fighting, crop spraying and the flying doctor service are common requirements for emerging nations, all of which could benefit greatly from the communication techniques outlined. Only limited electrical power is needed to support a radio data system and this can be derived from natural sources, such as solar cell arrays or wind power, without depleting costly oil reserves.

Small airstrips in rural areas do not even need to be permanently manned. Whether the runway is free of obstructions can be monitored using low power solid state lasers; the prevailing winds, the possibility of microburst, all of the data needed by pilots can be multiplexed adequately into a remote sensing system without the need for a fully trained complement of staff. Radio navigation beacons can be switched on if and when required.

Most of the technologies required to satisfy this type of communication are already developed. Low-cost power generation is one example. Ideally, any remotely-controlled monitoring system would need its full power only when directly operational. This is also true of mobile systems where battery power must be conserved. In the industrialised nations, radio paging is already commonplace and silicon chips have been developed which fully activate pagers in response to selective calling. When the paging receiver is on standby the power is conserved in a 'slumbering' or very low power mode.

Chips of this type can easily be incorporated into much larger radio systems, with other refinements following naturally once a network of outstations is established. Local communities could use the system to pass on simple messages to the administrative centres responsible for emergency and other services. No technical expertise would be required and even literacy need not be essential as pictograph keyboards could be developed.

In time, such remote centres could be equipped with teleprinting facilities for a fuller communications service. Indeed, planning for any new or expanding network of this kind should always take into account future possibilities for the incorporation of new technology.

Clearly, whichever development path may be chosen by the emerging nations, communications must be a key ingredient. This is particularly the case now that a range of technologies exists to satisfy this basic need without the prerequisite of financial resources or expert personnel beyond the immediate reach of the countries concerned.

Only the potential user is truly in touch with his specific and localised needs. Nevertheless, modern electronic technology should not be shunned merely because of its degree of sophistication. After all, one need not fully understand the process of internal combustion in order to drive a very fuel-efficient car. □

POSITIVE STEPS TOWARDS ISDN TECHNOLOGY

by Barrington G Lloyd

Above: *Developing nations should consider how they can combine the provision of basic telecommunications services with more sophisticated services for business users if they are not to suffer economically. Photo courtesy of Cable & Wireless.*

Business users in developing countries are likely to be the first to benefit from the introduction of the integrated services digital network, or ISDN. Yet its implementation is still a distant dream for most Third World PTTs. Barrington G Lloyd, writer on international communications and consultant to Plessey Telecommunications Ltd, suggests that the use of private ISDN networks could help to bridge the gap.

OVER the past five years or so, the term ISDN, or integrated services digital network, has come to dominate any discussion about telecommunications in developed countries – and with good reason.

For network operators, ISDN offers many economies: all services – voice, data, text and video – can be channelled down the same wires, at the same time if necessary, instead of going over separate networks as they do now. For users, it offers simple access from any telephone point to these wide-ranging services, some of them entirely new.

But for the world's developing nations – especially the poorest – ISDN must seem a supreme irrelevance. While rich countries are busy supplying users with new services, poor nations are struggling to provide even the most basic telephony. A recent estimate suggested that 60 per cent of the world's population has no access to any kind of telecommunications service.

Furthermore, these countries often lack the means – in particular the foreign exchange – to buy sophisticated modern technology. Consequently some hard decisions have to be made about priorities, often with the result that they decide to concentrate on providing a basic service using simple, conventional analogue technology. Only when this is established, so the argument runs, need these countries begin to offer more advanced services. This is, after all, precisely the way in which modern telecommunications networks emerged in most developing countries.

But there are good reasons why developing nations ought to look hard at this philosophy and try to find a more balanced approach in which both basic services and more sophisticated services such as ISDN could be offered where appropriate.

If they do not do this, developing countries are in great danger of falling even further behind economically. ISDN would give the all-important business subscribers a better service. It would enable them to use the network more cost effectively and establish much better links, both internally and with suppliers and customers.

This in turn would give those businesses an edge over competitors in other countries. Thus, by supplying businesses with the best and most modern services, countries could increase their efficiency, thereby increasing their wealth.

In any case, business users in developing countries are likely to demand these new services, especially if they have links with customers and suppliers in the developed world. In addition, these users are frequently significant generators of precious foreign currency, the very currency which is neeed to pay for Western technology.

There are, therefore, good reasons for giving business customers access to the same services as are available elsewhere in order to promote economic growth, efficiency and, not least, to boost the PTT's own revenue.

How, then, can ISDN be introduced to developing countries?

There is no doubt that the implementation of ISDN in the public network is a massive undertaking. It requires massive investment in digital exchanges and transmission equipment adapted for ISDN, as well as the terminals and access equipment. Even in rich countries, this is creating difficulties and in many places ISDN on the public network is likely to take several years to emerge.

There is an alternative option, however, which could have particular appeal for developing countries, namely the establishment of private ISDN networks, either on a single site or across a whole country. Unlike public ISDN, private ISDN is already available in a number of countries.

In a private ISDN, a company or organisation with a number of sites installs a digital private automatic branch exchange (PABX) adapted for ISDN and links the sites using speed (usually 2 megabits/second) digital transmission lines. A number of customers are already using these exchanges for integrated digital network trials. They include the UK Atomic Energy Authority and Bank of America, and more are expected to follow suit soon. All these networks, it should be noted, are in place before British Telecom has begun offering a public ISDN service. In principle, any other country could do the same.

A private ISDN network of this type has four basic ingredients.

☐ A digital PABX adapted for ISDN. This means it must be capable of offering two 64 kilobits/second (kb/s) communications channels and one 16 kb/s signalling channel to each telephone point over conventional twisted pair telephone wiring. This is basic rate, or 2B+D ISDN access, and it will provide ISDN to any current telephone user. No rewiring is required.

☐ If separate sites are to be linked, the user must lease 2 megabits/second (mb/s) lines from the local PTT. This provides 31 communications channels operating at 64 kb/s, and one signalling channel, and is called primary rate access ISDN, designed to link PABXs.

☐ Each user must also have a dedicated terminal. The most important feature of this device is that any terminal equipped with a general purpose interface, such as a X21 or V24 port, can be linked to it – for example, a facsimile transceiver, a personal computer, a telex or teletex terminal or a videotex terminal. These terminals can then get 64 kb/s access to the ISDN network.

☐ Finally, there must be a so-called 'common channel' signalling system between sites, which allows all the features of the digital exchange to be offered transparently throughout the network. At present, the United Kingdom is the only country which has developed such a signalling system, known as DPNSS. It has been adopted by all the country's major PABX manufacturers and efforts are now underway to get it adopted as an international standard.

The smallest digital exchange comes with only 30 extensions, but it uses exactly the same technology as the largest models.

Perhaps the most important single point about a private network based on a digital exchange, and one which is especially relevant in developing countries, is that users can buy a small fully-fledged ISDN network at a later date.

In many less developed countries, 2 mb/s leased lines are not yet available. Nevertheless, users can buy systems for a single site, and link them to other sites when these lines become available.

Furthermore, the ISDN PABX is based strictly on the recommendations for ISDN adopted by the International Consultative Committee on Telegraph and Telephone (CCITT). This means that when local PTTs begin to offer ISDN, exchanges of this kind can gain access to this network without any modification.

For users in developing countries, therefore, a good plan might be to begin by installing an ISDN PABX on one site to experiment with new services. They can then add ISDN PABXs at other sites and link them when 2 mb/s lines and an ISDN signalling system become available. As ISDN spreads through the network, smaller, remote sites can be added, as well as suppliers and customers. Ultimately, such connectivity will be available worldwide.

Because ISDN is an international standard, most analysts expect a whole range of ingenious new services to be developed for it in the future. Users will be able to incorporate these into their own networks with little modification, and at little extra cost. Possibly as many as 90 per cent of the ISDN services which will be available in the year 2000 have not yet even been considered.

Firstly, the ability to send and receive two channels simultaneously ought to result in many new services. For example, two engineers could send documents or technical data to each other's PCs or fax machines while having a telephone conversation. Similarly, two businessmen could send written confirmation of orders – even a contract – while on the phone.

Secondly, the use of common channel signalling will allow users to improve conventional services in a variety of ways. On the digital exchange, for example, a display will tell the user when anyone else is calling him during a conversation, and who that caller is.

Users can even accept incoming calls while making outgoing calls on the same terminal, or send text messages to the second caller while still on the line to the first caller.

Of particular relevance in developed countries is the ability to cut telephone bills with a digital exchange. Any user can be barred at any time from making long distance or peak period calls. And a user who is authorised to make such calls can do so from any terminal by entering his own personal code.

Other possibilities include:

☐ greater access to pooled resources such as modems or packet switches;

☐ the implementation of new types of 'mixed mode' terminals as these become available, such as computerphones or videophones;

☐ high-speed transfer of documents: an ISDN fax machine can send an A4 document in one second;

☐ use of the network for holiday, hotel or airline booking, or for credit verification.

Other services which could be made available include:

☐ multi-slotting, in which a user can get access to more than one 64 kb/s channel. For example, a 384 kb/s channel could be used to make a videotelephone call or for high-speed file transfer;

☐ an interface between the PABX and mainframe computers.

These services are all in addition to those already implemented on conventional digital PABXs. In the case of the ISDN PABX, over 100 such services are available, ranging from diversion of calls when an extension is engaged to abbreviated dialling, automatic redialling, hands-free operation, and so on. And one of the beauties of digital technology is that new services can be offered at very little extra cost to the user.

With such sophisticated equipment it might be thought that there would be a shortage of skilled staff able to carry out maintenance, even in developed countries. In fact, if anything, it will be easier to maintain than existing equipment. To start with, a digital PABX is much more reliable than the previous generation of PABXs. All critical components are duplicated and in practise this means major breakdowns can be expected only once every few weeks.

Even if there are faults, they are easier to fix. Frequently, all that is required is the removal of a faulty printed circuit board, and its replacement with a new one, something which can easily be carried out by unskilled personnel. A further improvement is that, where a number of PABXs are installed throughout a country, troubleshooting can be carried out from a central site using data lines. If maintenance is necessary, technicians can use this facility and go to the site knowing exactly what is wrong, equipped with the right tools and parts to fix it. Similarly, a digital exchange can be updated with new features simply by sending a software suite down a data line.

A digital PABX is also easier for unskilled staff to manage. On old PABXs, circuit rearrangements required complicated wiring changes, but on a modern PABX this can be achieved via a few keystrokes on a central console. A digital exchange also provides users with comprehensive statistics on usage so that they can adapt it, plan for future growth and change user behaviour if costs are too high.

Developing countries are now starting to use digital exchanges based on ISDN. In Oman, the army and navy are to implement a network of exchanges linked by digital lines and closely based on a similar network used by the British army. In India, the Taj Hotel group has ordered a number of PABXs for installation throughout the country. And in China, a number are now being installed in large businesses such as steel works. In many cases, the buyers are significant earners of foreign exchange.

In the case of China, a service centre has been implemented at a Ministry of Posts and Telecommunications factory with the aim of phasing the introduction of the integrated digital exchange over a number of years. Eventually it will be wholly assembled in China.

Summing Up

To sum up, then, the advantages of installing ISDN PABXs are as follows:

☐ digital technology means easier maintenance and supervision routines, and thus requires less skilled staff;

☐ it will give local businesses access to all the services available in developed countries, enabling them to maintain good links with counterparts, suppliers and customers in other countries and thereby contributing to economic growth;

☐ it enables local administrations to offer ISDN services without the massive expense of installing a nationwide network of digital switches and transmission equipment;

☐ it increases PTT revenue, which can then be used to improve the network in other areas; and

☐ it will not be made obsolescent by changes in technology, and can be used as the basic building block for the future implementation of national ISDN plans. ☐

KEEPING COMMUNICATIONS COSTS DOWN

by Gösta Linder

Cost-effectiveness has to be a priority in all forms of communications planning, especially when there are constraints on finance. Linking remote locations with a data communications network, for instance, should aim for a balance of efficiency with minimum investment. Gösta Linder, Strategic Product Manager of Ericsson Telecoms explains how this can be achieved using private automatic branch exchanges in conjunction with the public network.

TELECOMMUNICATIONS administrations are responding in a number of ways to the opportunity to provide cost-effective business communications for organisations with multiple sites. The support being provided may be given in different stages and in accordance with different time schedules, but the strategies being adopted by the various administrations – British Telecom and the Spanish PTT are representative examples – bear a strong resemblance.

The essential challenge is to introduce digital 64 kilobits/second (kb/s) end-to-end communication in the public network and thereby increase the speed of communications above today's 2.4 kb/s and 4.8 kb/s. Intelligent end-to-end PABX-to-PABX signalling will also be supported over the public network. And, at least within metropolitan areas, 2 megabits/second (mb/s), 30-channel leased end-to-end communication will become available.

Usually, however, an organisation requires only a limited number of 64 kb/s communication channels, rather than a complete 30-channel (2 mb/s) system linking remote locations. In such cases, an optimised use of the available public transmission network is required.

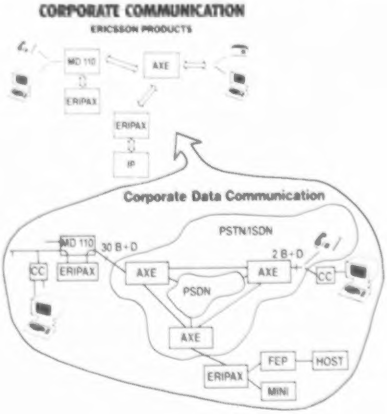
Accordingly, telecommunications manufacturers are working with the administrations to develop new ways to optimise use of long-distance transmission systems. These solutions are based on the ability to book single 64 kb/s channels instead of complete 30x64 kb/s (2 mb/s) systems in the long-distance public network.

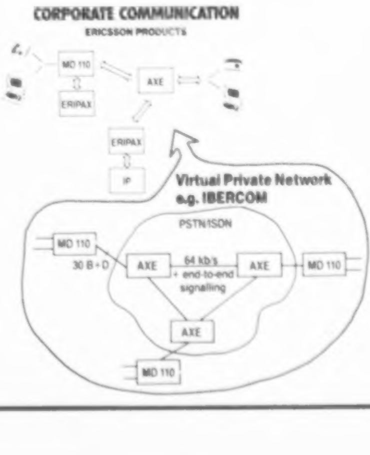
The idea is to use one of more 30x64 kb/s (2 mb/s) systems to connect PABXs to the closest public switch. To define the network, some of the 30 64 kb/s channels may be allocated for one destination, while others are assigned to another fixed destination. PABX-to-PABX end-to-end circuit in the network.

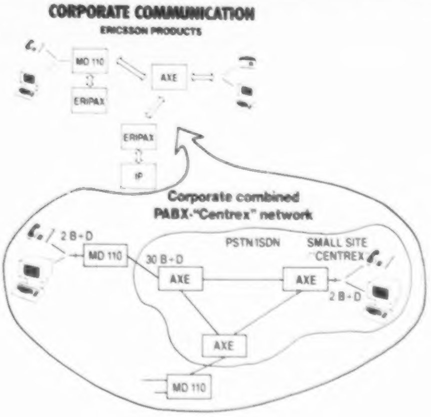
Using this solution, only the number of 64 kb/s channels that are specifically needed have to be booked and reserved for corporate communications, thereby optimising use of the public digital network at a channel level of 64 kb/s.

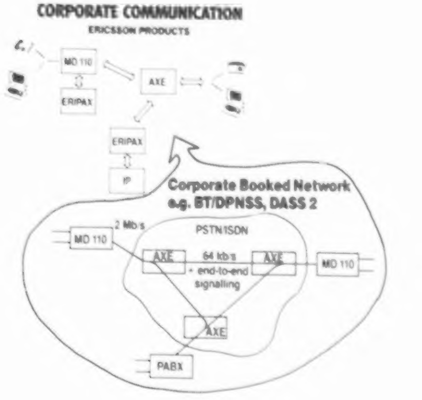
The signalling channel in the 2 mb/s interface between the PABX and the public switch is employed to carry both the PABX-to-PABX end-to-end signal and the network signal between the PABX and the public network. The PABX-to-PABX signals between the public switches are transmitted via CCITT (International Consultative Committee on Telegraph and Telephone) signalling system No. 7.

Compared with the use of pre-assigned signalling channels end-to-end in corporate


CORPORATE COMMUNICATION
ERICSSON PRODUCTS
MD 110
AXE
ERIPAX
ERIPAX
IP
Corporate Data Communication
PSTN/ISDN
MD 110
30 B+D
2 B+D
CC
ERIPAX
AXE
AXE
CC
PSDN
AXE
FEP
HOST
ERIPAX
MINI


CORPORATE COMMUNICATION
ERICSSON PRODUCTS
MD 110
AXE
ERIPAX
ERIPAX
IP
Virtual Private Network
e.g. IBERCOM
PSTN/ISDN
MD 110
30 B+D
AXE
64 kb/s
+ end-to-end
signalling
AXE
MD 110
AXE
MD 110


CORPORATE COMMUNICATION
ERICSSON PRODUCTS
MD 110
AXE
ERIPAX
ERIPAX
IP
Corporate combined PABX-"Centrex" network
2 B+D
MD 110
PSTN/ISDN
SMALL SITE CENTREX
30 B+D
AXE
AXE
2 B+D
AXE
MD 110


CORPORATE COMMUNICATION
ERICSSON PRODUCTS
MD 110
AXE
ERIPAX
ERIPAX
IP
Corporate Booked Network e.g. BT/DPNSS, DASS 2
2 Mb/s
MD 110
PSTN/ISDN
AXE
64 kb/s + end-to-end signalling
AXE
MD 110
AXE
PABX

networks, this is a much more effective solution. British Telecom has already defined the support needed for PABX-to-PABX booked channels, and two standards, commonly designated DPNSS and DASS 2, are being used to integrate the new service in the BT network.

DASS 2 specifies the PABX-public switch interworking, including the transportation of signal information from one PABX to another.

DPNSS defines end-to-end interworking: that is, the feature interworking between the corporate PABXs. The PABXs might be connected directly or via the public DASS 2 interface acting as the signal transport medium through the public network.

A number of PTTs have selected what has been termed the virtual private network as a means of supporting corporate communication via the public network. It differs from the corporate communication support described earlier mainly in that it requires the allocation of PABX-to-PABX 64 kb/s channels in the public network only when actually needed: during the voice/data communication phase.

This efficient allocation of 64 kb/s channels is provided in such a way that extensions in each corporate PABX are dialled as if they were linked directly to the originating PABX. All PABX-to-PABX features are available in the virtual private network. The procedures used are identical with those used in end-to-end communication over private lines in a corporate network.

Some corporate customers have centrex systems (supported through a central office) in certain locations and PABX systems in others. To meet the needs imposed by mixed systems, a number of PTTs are planning to introduce interworking between centrex extensions and PABX extensions.

However, standards defining the interworking between extensions served by public networks and those connected to PABXs are lacking. Standardisation bodies are working on this problem, with the objective of defining interworking within the scope of integrated services digital network (ISDN)/30B+D.

There are other situations where the ISDN 64 kb/s communication channels can be utilised most efficiently as high-capacity links in vendor-specific data communications networks.

Corporate packet switching can provide an even more cost-effective solution, however, depending on the site-to-site distance and the number of terminals communicating with a remote site.

Packet switching can be supported in two ways: by superimposing a corporate packet switch network within the corporate 64 kb/s backbone network or by means of a public packet-switched network accessed via the ISDN 64 kb/s network.

In company locations with a high volume of data traffic to other corporate sites, the packet switch node is located at the primary site in order to optimise network utilisation. This node is connected to the node at the remote site via 64 kb/s end-to-end communication channels or through the public packet switched data network (PSDN). In the latter case, the ISDN network is used as an access network in front of the PSDN. □

269

INTRODUCING ISDN

by Y Kotaka

The integrated services digital network or ISDN, promises an innovative future for information technology. Its implementation can only be gradual, however, taking into account existing communications networks. Y Kotaka, Vice President of NEC Corporation, describes the different versions of ISDN and explains how they will be put into operation.

STEPS are being taken worldwide towards the implementation of the integrated services digital network, or ISDN, in communications networks. Ultimately, this could make possible global exchange of information in the form of data, voice, text and video between the world's population.

In many nations, however, such a scenario is virtually inconceivable when even telephone penetration is minimal. But wherever ISDN is having more of an impact the progress towards its full operation can only be achieved in cooperation with existing networks, whether they are quite sophisticated or relatively basic.

This process can best be considered if ISDN is divided into three versions, based on its present status (including those systems now under study) and two stages of its potential for future development (see Figure 1).

Various versions of ISDN

Version 1, based on the present Red Book issued by the International Consultative Committee on Telegraph and Telephone, offers IDN based mainly on 64 kilobits/second (kb/s). Most of the systems now under field tests in several countries fall within this category.

Basically this version covers circuit switching and digital leased line (fixed connection) services, and partially includes packet switching functions.

Version 2 of ISDN is based on the Blue Book, making faster bit rate transmission possible. Packet/burst category network functions, capable of responding to plural transmission speeds, will be realised within this version.

Further to this, version 3 of ISDN will contain so-called information processing/storage functions as network functions.

If a functional overview is considered, it can be seen that versions 1 and 2 are basically transparent networks while version 3 covers value added networks.

Figure 2 shows the general structure of the ISDN system in the overall context of modern communications in three systems: terminal system, user access system and wide area network system.

The role of ISDN

Figure 3 shows the relationship between each of the three versions of ISDN and the functions of information generation, transfer and storage.

Versions 1 and 2 of ISDN provide basic information transfer functions, as shown in Figure 3. However, in addition to this, new services, using combined, multiplexed or high-speed terminal interfaces, are offered at the ISDN subscriber terminals, in a form combining the functions of various information service centres (mainly consisting of computers), which may be connected in the form of terminals in the wide sense, outside of ISDN.

Version 3 ISDN will begin to offer various information service centre functions as functions within ISDN, so more combined intelligent services than those available in versions 1 and 2 will be provided to users. ISDN will be understood as value added networks equipped with information generation and storage functions within networks. Thus the overall relationship between ISDN and modern communications may be expressed in the following way.

ISDN will facilitate information transfer, in order to realise information communication systems in the future modern communications environment, as shown in Figure 2. Information service centres to be installed within ISDN will sustain information generation (processing) and storage (retrieval) functions.

In summary, modern communications systems can be understood as connecting collectively various and abundant information generation (processing) and storage (retrieval) functions (usually by computers), to be installed outside of ISDN, that is, at terminals in the wide sense, based on these ISDN functions.

The two stages of ISDN evolution

Extant electrical communications networks have a history of just over a century. Their functions and services are diversified, and the size and area they cover have expanded to a global scale. Mutually, they function as a

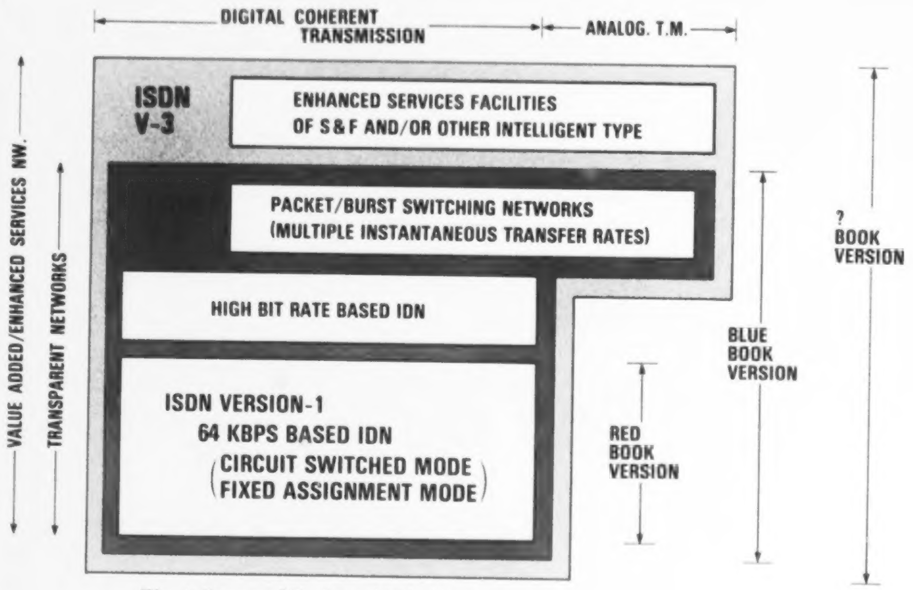

DIGITAL COHERENT TRANSMISSION
ANALOG. T.M.
ISDN V-3
ENHANCED SERVICES FACILITIES OF S&F AND/OR OTHER INTELLIGENT TYPE
PACKET/BURST SWITCHING NETWORKS (MULTIPLE INSTANTANEOUS TRANSFER RATES)
HIGH BIT RATE BASED IDN
ISDN VERSION-1
64 KBPS BASED IDN
(CIRCUIT SWITCHED MODE
FIXED ASSIGNMENT MODE)
VALUE ADDED/ENHANCED SERVICES NW.
TRANSPARENT NETWORKS
RED BOOK VERSION
BLUE BOOK VERSION
? BOOK VERSION

Fig. 1 Scope of Various ISDN Versions

highly developed body to provide users with various services.

Given this situation, it would be unrealistic to abolish and replace these communications networks when introducing ISDN into actual service. Therefore, it is important that ISDN should be introduced gradually, in coexistence with current communications networks.

The evolution from current telecommunications networks to ISDN networks is envisaged as two basic steps, as shown in Figure 4.

At the moment, ISDN systems are likely to be used alongside current telecommunications networks. The first step, to take place in the near future, will involve the gradual penetration of ISDN networks. From this, their use will gradually expand to the majority stage, in which almost all the now familiar communications networks will be replaced by ISDN.

In the existing telecommunications network environment, the terminal is basically defined and contained within its particular telecommunications network, as shown on the left-hand side of Figure 4. It is usually difficult to communicate directly from one terminal to another in a different network.

As a solution, the ISDN switch will be introduced, as shown in the middle of Figure 4, the penetrating stage. This functions as a gateway to a plural number of networks for any given terminal. Basically, a terminal will be able to access terminals accommodated in almost all kinds of existing networks.

With time, as ISDN switches with this gateway function are subsequently introduced and existing communications network facilities are gradually replaced, one network, connecting ISDN switches directly along a digital transmission route, will appear, as shown at the right-hand side of Figure 4. This marks the advent of the majority stage.

In this stage, it will become possible to provide users with more integrated and advanced services, through various information service centres installed inside and outside ISDN networks.

The use of the ISDN switching system in the penetrating and majority stages

The ISDN switching systems penetrating stage covers the beginning and middle period of introducing ISDN, corresponding to versions 1 and 2 as shown in Figure 1. Here, ISDN is basically a transparent network that offers an information transfer function from a 64 kb/s base. Switching functions will be realised in a similar manner to conventional switching equipment except for the detailed call control

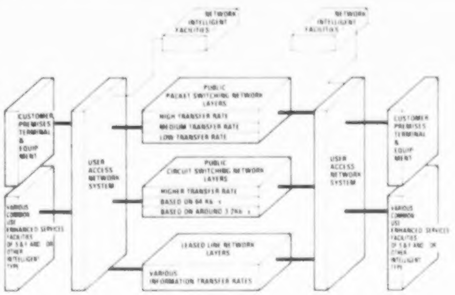

NETWORK INTELLIGENT FACILITIES
NETWORK INTELLIGENT FACILITIES
CUSTOMER PREMISES TERMINAL & EQUIPMENT
VARIOUS COMMON USE ENHANCED SERVICES FACILITIES
USER ACCESS NETWORK SYSTEM
PUBLIC PACKET SWITCHING NETWORK LAYERS
HIGH TRANSFER RATE
MEDIUM TRANSFER RATE
LOW TRANSFER RATE
PUBLIC CIRCUIT SWITCHING NETWORK LAYERS
HIGHER TRANSFER RATE
BASED ON 64 Kb/s
BASED ON AROUND 3.2Kb/s
LEASED LINE NETWORK LAYERS
VARIOUS INFORMATION TRANSFER RATES
USER ACCESS NETWORK SYSTEM
CUSTOMER PREMISES TERMINAL & EQUIPMENT
VARIOUS COMMON USE ENHANCED SERVICES FACILITIES

Fig. 2 ISDN System Architecture

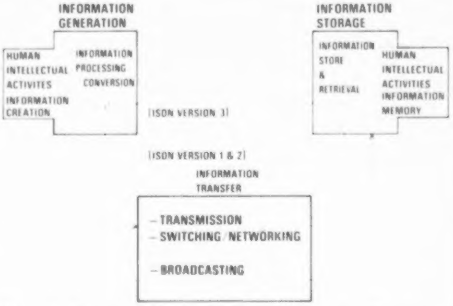

INFORMATION GENERATION
HUMAN INTELLECTUAL ACTIVITES
INFORMATION CREATION
INFORMATION PROCESSING CONVERSION
INFORMATION STORAGE
INFORMATION STORE & RETRIEVAL
HUMAN INTELLECTUAL ACTIVITIES INFORMATION MEMORY
(ISDN VERSION 3)
(ISDN VERSION 1 & 2)
INFORMATION TRANSFER
– TRANSMISSION
– SWITCHING/NETWORKING
– BROADCASTING

Fig. 3 Scope of ISDN Versions in Terms of Three Fundamental Information Handling Function of "C&C"

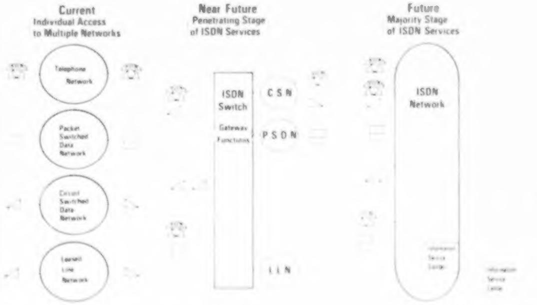

Current Individual Access to Multiple Networks
Near Future Penetrating Stage of ISDN Services
Future Majority Stage of ISDN Services
Telephone Network
Packet Switched Data Network
Circuit Switched Data Network
Leased Line Network
ISDN Switch
Gateway Functions
CSN
PSDN
LLN
ISDN Network
Information Service Center
Information Service Center

Fig. 4 Two Basic Steps of The ISDN Evolution

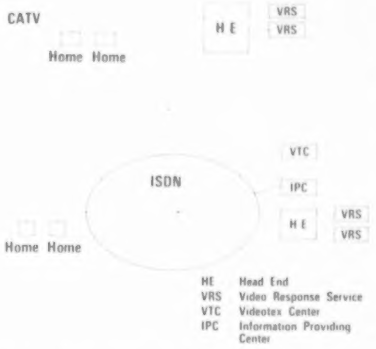

CATV
Home Home
H E
VRS
VRS
ISDN
VTC
IPC
H E
VRS
VRS
Home Home
HE Head End
VRS Video Response Service
VTC Videotex Center
IPC Information Providing Center

Fig. 5 Extended CATV Service by ISDN in Majority Stage

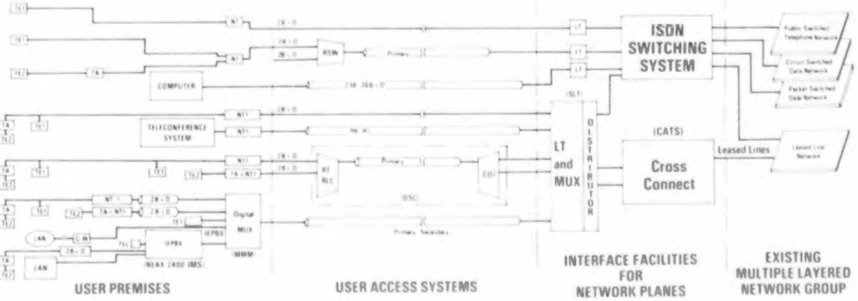

TE1
TA
NT1
2B + D
RSW
Primary
COMPUTER
TELECONFERENCE SYSTEM
NT1
TA + NT1
RT RLC
COT
DSC
Digital MUX
LAN
IEPBX
NEAX 2400 IMS
LT
ISDN SWITCHING SYSTEM
(SLT)
LT and MUX
DISTRIBUTOR
(CATS)
Cross Connect
Leased Lines
Public Switched Telephone Network
Circuit Switched Data Network
Packet Switched Data Network
Leased Line Network
USER PREMISES
USER ACCESS SYSTEMS
INTERFACE FACILITIES FOR NETWORK PLANES
EXISTING MULTIPLE LAYERED NETWORK GROUP

Fig 6. ISDN System for Penetrating Stage of ISDN Service

function, because the fundamental circuit switching functions and packet switching functions will be provided even at this stage.

However, the one area of new development that does exist at this stage is the user access system in order to realise the user access interface specified in the CCITT Red Book. This provides users with a faster digital multiplex transfer function and a standard network interface.

In the majority stage, the kind of information to be carried via ISDN will expand and be diversified into areas such as voice, data, text, still picture and moving picture. In addition, not only the simple transparent transfer of each bit of information, but also the transfer of various kinds of information in the combined form, as well as information storage and retrieval functions, information processing and conversion functions will be provided by the ISDN.

For this purpose, it is necessary to add the storage, processing and conversion functions for various kinds of information, in addition to switching functions in the narrow sense. Broadband switching functions should be added in order to accommodate media such as moving pictures. Moreover, characteristics of traffic to be switched (continuous/separate, bidirectional/unidirectional, balanced/unbalanced) will become diversified and switching control itself will become exceedingly advanced and complex.

Because of this, the user access system will become more rapid, and the functions to embody broadband service, which is already being studied by CCITT, will become necessary. In other words, while the user access system in the penetrating stage is likely to be based on the existing metallic subscriber lines for telephone, it may become necessary to introduce optical fibres and Community Antenna Television (CATV) systems.

Using these high-speed user access systems, future home services will exceed anything in existence. A typical example of future home services is CATV working in conjunction with ISDN, i.e. the future multifunctional CATV will be offered by the combination of so-called CATV centre, data base centre, videotex centre and so on, which are accommodated to ISDN (see Figure 5).

The ISDN system structure in the ISDN penetrating stage

Figure 6 shows an example of ISDN system architecture performing the gateway function in the penetrating stage. This system consists of three portions: user premises, user access system and interface network facilities.

At the right-hand side of Figure 6 various existing networks are indicated. The user premises shown at the left-hand side include various network terminations (NT) and terminal adaptors (TA) which provide the terminal equipment (TE) with a user network interface, corresponding to the scope specified in the CCITT Red Book.

These NT and TA include intra-premises communication systems, such as multi-media multiplexer (MMM), private branch exchange (PBX) and local area network (LAN) in a narrow sense, for using high-speed multiplex circuits economically. Connected to them are various terminals (telephones, data terminals, image terminals, ISDN terminals, computers, etc.) which users can utilise directly.

These user premises are connected to interface facilities, comprising switching equipment and cross access and test system (CATS), by user access systems.

The latter include various systems which make possible basic access, and primary and secondary access as specified in the CCITT Red Book. Remote switch (RSW) and digital subscriber carrier (DSC) are introduced for economic long-distance transfer. These user access systems are important parts of the ISDN system and a key factor in making the entire system economical.

The interface facility portion functions to connect customer premises to various existing networks, under a standard interface specified as ISDN, and generally comprises equipment installed in central telephone offices.

The interface facility services can be divided into two parts: the so-called switching service provided by ISDN switching system; and the leased line service provided by subscriber line termination (SLT) and cross access and test system (CATS). The subscriber line termination (SLT) and ISDN switching system are connected as shown in Figure 6. The terminals of the leased line system are connected to existing public networks. The SLT and CATS systems are primarily connected to the leased line network, shown at the right-hand side of the figure.

Thus ISDN switching systems will initially be installed as interface facilities, connected to existing networks. In this way the ISDN network share will increase and gradually evolve toward the majority stage.

From an overall viewpoint, the upper half of Figure 6 shows the so-called ISDN networks for general use, centreing on switching services. The lower half shows ISDN for so-called business users, centering on ISDN category PBX, LAN and leased lines. □

ENCOURAGING THE USE OF INFORMATION TECHNOLOGY

by Riccardo Rietti

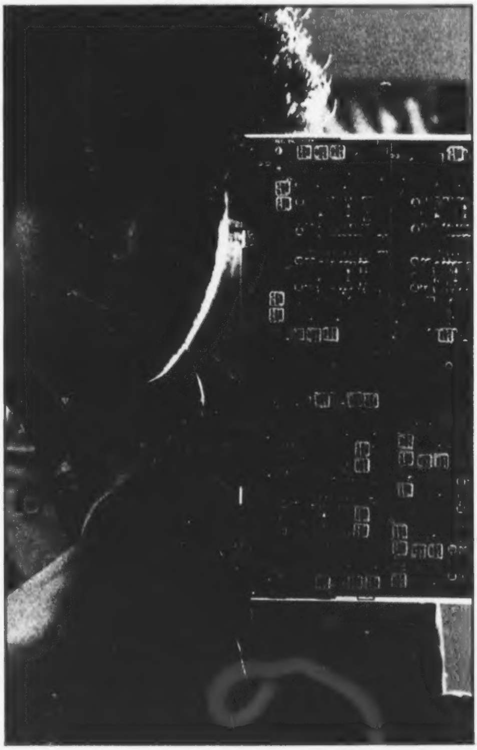
Too often the potential for introducing information technology systems to developing countries is assessed without real regard for the requirements of users in those countries. Riccardo Rietti, MarketingDirector of Televas SPA, outlines an approach which puts the customer first.

MASSIVE problems of underdevelopment, underfinancing and overutilisation of network infrastructures do not generally trouble the industrialised world; they are, however, at the core of the development of telecommunications infrastructures and the acquisition of information technology in less advanced nations.

Until a few years ago, a telephone was a telephone, and a computer was a computer, and anybody could tell the difference. Today, however, telephones routinely boast computer intelligence and computers are discovering the power of networking.

The name of the game is getting the right information to the right people at the right time. This capability brings with it greater productivity and efficiency. The new trend in telecommunications is networks that not only move information instantly, but also interpret it, rearrange it and apply it in the most useful ways.

The upgrading of network infrastructures – the prerequisite for modern applications of information technology – always demands enormous capital outlay, especially for those countries attempting to develop a very basic infrastructure. The main problem is the overwhelming lack of resources.



Right: The use of Information Technology is fundamental to the progress of underdeveloped countries. It can, however, only be established if systems are related to the requirements of individual countries, where local people must be trained to realise the value of Information Technology and how it can be used most effectively.

In many developing countries the health, agriculture, education, transportation and, at times, the housing sectors, are likely to have a greater claim on funding than telecommunications. Yet investments in telecommunications are closely tied to improvements in the basic economy, with significant benefits from such investments redounding to the other core sectors. The first step is to identify the options available within developing countries for the creation of know-how and organisational efficiency in the area of telecommunications and information technology.

Information is important for the generation and flow of useful knowledge. It is normally argued that development is absolutely dependent upon the effective dissemination of information between similar types of users in different countries. In effect, this is often limited to the transfer of technological knowledge from developed countries to those deemed able to use it effectively in less developed countries (quite a demanding pre-condition to satisfy). In this context information is often treated as one homogeneous commodity with a certain set value which, in reality, is obviously not the case.

The state-of-the-art application of information technology in less developed countries is affected by a number of serious constraints. Traditionally, the type of information technology available seems to predetermine its potential application by people geographically, economically and technically remote from its source. In addition, the factors inhibiting the transfer of information technology are always assessed from the perspective of a Western technology provider.

There are a vast number of information or service providers which offer their services to less developed countries. Some of these are commercial enterprises, others are backed by international bodies. Normally, these organisations perceive themselves as offering useful knowledge to those who need to know. However, the majority of potential users are likely to become frustrated by their inability to contact the possible suppliers directly, or to access the store information once contact is made.

Ideally a communications systems supplier should give all its potential users the broadest possible freedom, inasmuch as it does not impose any pre-packed solution, especially when telecommunications are involved. Users should be able to select the information processing system and communications network that may best meet their requirements. This should have the potential to connect with the most varied telecommunications networks, send data at various transmission speeds and support the most common communication protocols. This applies to every component of the system, namely the communications network, data processing equipment.

The best system is likely to be:

☐ modular and easily adjustable to the specific requirements and conditions of a given user (business or country);

☐ able to be integrated with the user's own resources (internal/local);

☐ able to be designed upon the specific characteristics of a given territory, available network and individual needs.

In the less developed world, one may find countries where the primary needs of health and agriculture urgently need support in order to achieve the primary development process. Other countries, meanwhile, may already be in a position to entertain business and trade relationships with the rest of the world, although normally under the terms and conditions imposed from outside.

The aim should be to avoid establishing a *de facto* dependence connection, instead offering access to a telecommunications technology aimed at encompassing the components of an information processing system. A gateway to international information providers should be combined with the retention and improvement of indigenous know-how and technological development.

In the history of human progress it has always been the socio-economic system, not the technology itself, which determines the best use of the latter. The same applies to information technology. We think that we know how technology should be used, but eventually it is the socio-economic conditions in a given country which will decide whether or not and for what purposes it will be used.

In an ideal situation, these decisions are a matter of the user's, that is of local, perogative. People must be made aware of the value of, and be trained to use effectively, the new information technology. This awareness must be translated into real, practical support for the progress of less developed countries and, above all, the traditional constraints normally affecting the use of information technology in these countries should be avoided at all costs. Telecommunications and information processing, at whose cornerstone the new science of information technology stands, are the means to rapid advancement in the direction of socio-economic improvement. ☐

Integrating the Computer and Telephone

Information has become the fourth factor in production, and possibly the most essential. Managing information efficiently has become the key to making any company successful. But to do that, you need to integrate all the data now available in the office and factory.

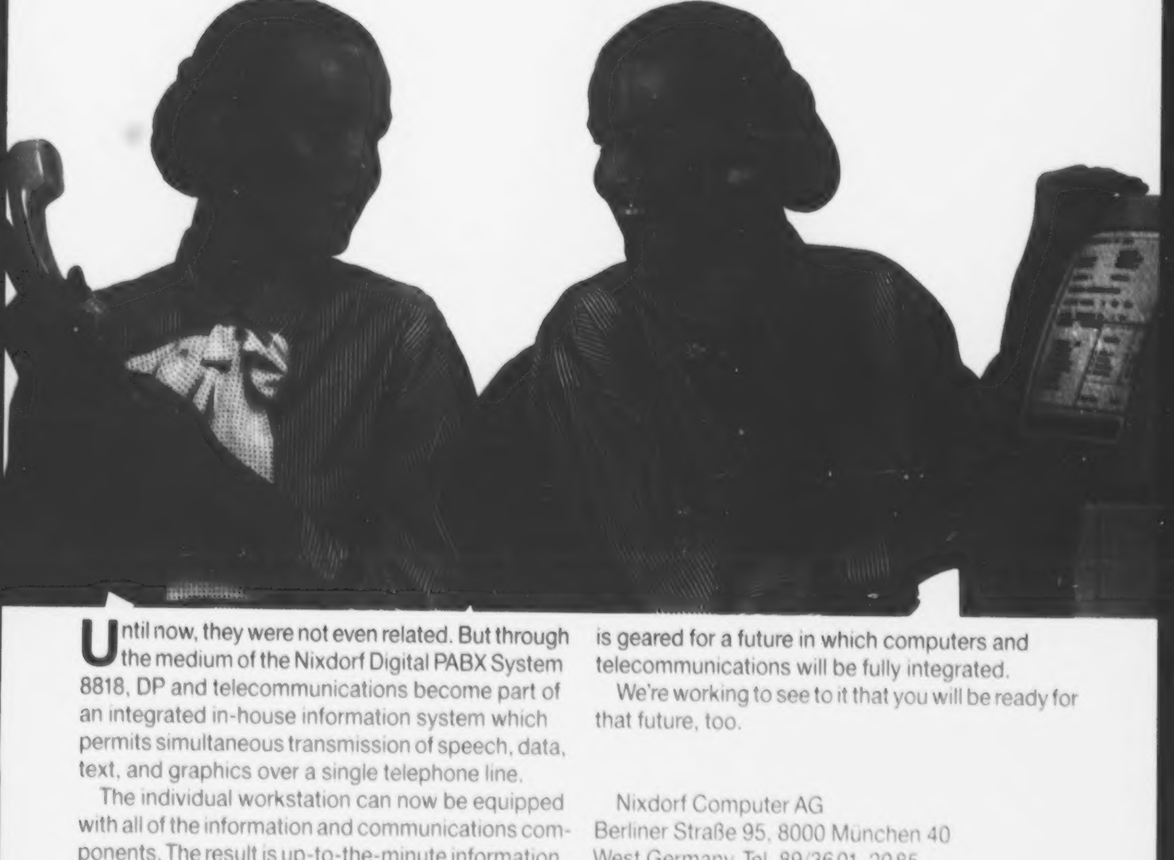
Integration is made possible through the convergence of computer and communications technology. This allows you to process different forms of information like voice communications, data, text and graphics through a single medium. It helps you interconnect all information sources right down to workstation level.

Nixdorf offers all the components required for integrating the information flow in a company organization, as needs dictate. It supplies computers and terminals tying offices and departments into a single information (and productive) network system that combines data processing with word processing and interoffice communications.

Integration the Nixdorf way in the office environment is based on the ISDN 8818 digital switching system. With an installed base of 2,500, this system is a digital PABX supporting any number of extensions from 30 to 3,000 and interconnecting data terminal equipment through standard interfaces (V.24, X.21). While telephoning with the Nixdorf Digifon digital telephone or the BT01 videotex/telephone terminal, desktop users can simultaneously interact with videotex or access a data base – if ever they need extra facts. As an LAN, the Nixdorf Broadband Network (NBN) allows high-speed data communications between Nixdorf and other computers. Linked through gateways, the ISDN system Nixdorf 8818 and NBN stretch a company's integrated information processing operation to any location in the company organization.

Nixdorf uses standard interfaces and network standards. Its concept of integrated information processing allows office users to access telecom services like telex, teletex and videotex, and share their information with colleagues in other departments through data communications between their terminal and the company mainframe. By making all its systems work together, Nixdorf is helping end-users work better together through multi-functional terminals on their desktops.

Nixdorf turns DP and telecommunications into twins



Until now, they were not even related. But through the medium of the Nixdorf Digital PABX System 8818, DP and telecommunications become part of an integrated in-house information system which permits simultaneous transmission of speech, data, text, and graphics over a single telephone line.

The individual workstation can now be equipped with all of the information and communications components. The result is up-to-the-minute information, greater flexibility, and increased productivity.

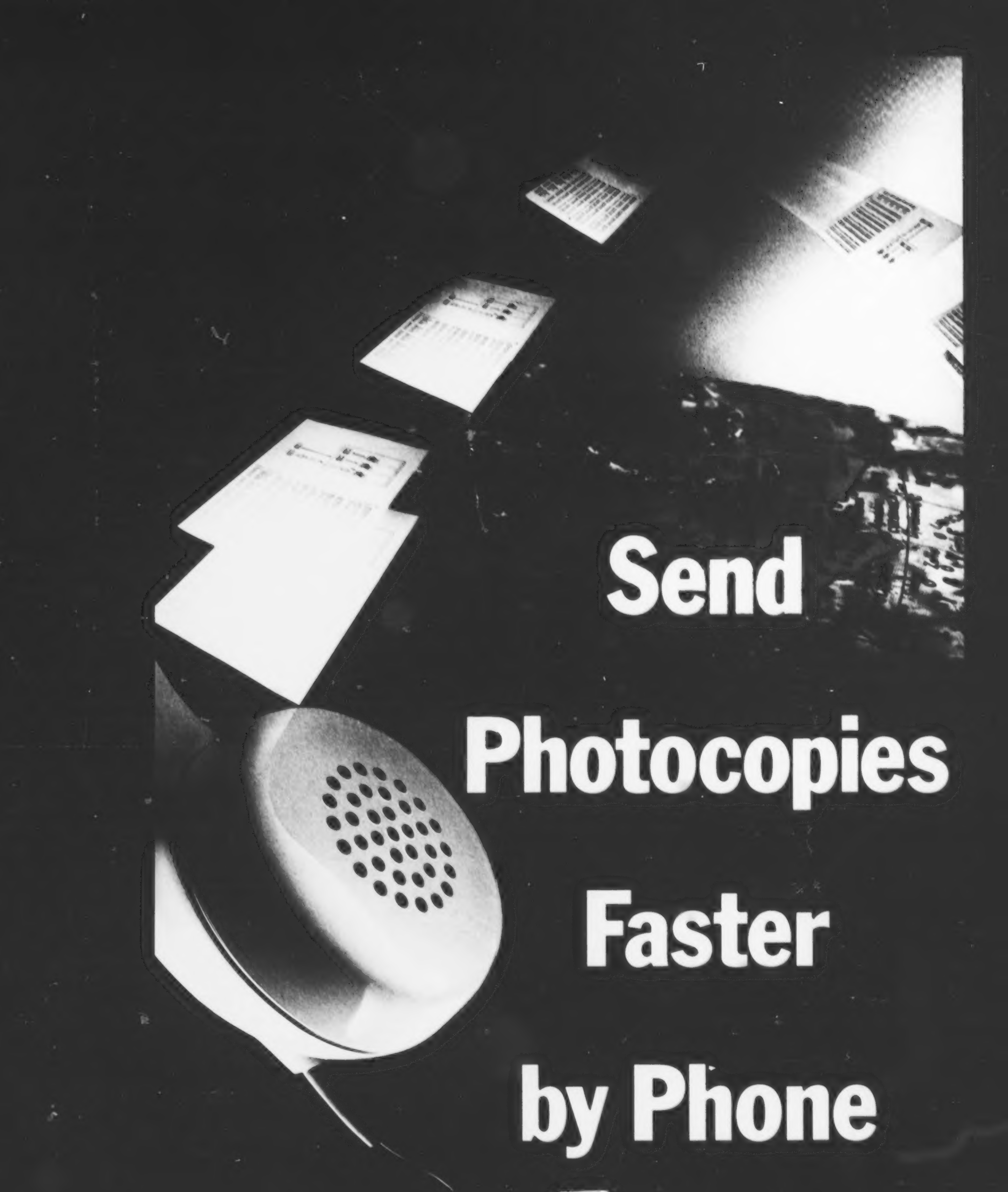
The system is future-proof. In time, it will become part of the international ISDN network. It should come as no surprise that Nixdorf is at the forefront of this important development: One of the first operational digital PABX units in the world was invented by us. So don't let artificial restraints on your vital information flow hold you back. Pick up your now obsolete telephone, and call us for a PABX System 8818.

Nixdorf is a computer company. But more than that, we are a telecommunications company which is geared for a future in which computers and telecommunications will be fully integrated.

We're working to see to it that you will be ready for that future, too.

Nixdorf Computer AG
Berliner Straße 95, 8000 München 40
West Germany, Tel. 89/3601-2085

NIXDORF
COMPUTER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BECKMAN INDUSTRIAL: FIFTY YEARS A LEADER IN INSTRUMENTATION

The name of Beckman has been associated with scientific instruments since 1935 when Dr Arnold O Beckman developed the world's first pH meter. Today, Beckman Industrial is a multi-million dollar corporation, recognised as a leading international manufacturer of test and measuring instruments and electronic components. Now a subsidiary of Emerson Electric, the company has an impressive product line renowned throughout the world for dependability, reliability and high overall quality.

These important factors make the instruments ideal for the communications field. They are used worldwide by the PTT's, the utilities and in the aerospace and defence industries. They are also widely used in industry, laboratories, educational establishments and, in the field, by service engineers. In addition the lower priced versions are used in the home and by hobbyists.

The heavy-duty HD130 multimeter, with true RMS measurement

An example of Beckman Industrial's leadership with the PTT's is the fact that, for the second year in succession, the company was awarded the contract for the supply of handheld digital multimeters to British Telecom. This is one of the largest orders ever placed in Europe for digital multimeters.

Outside of the UK, Beckman Industrial has been supplying multimeters to the PTT's of other countries since 1979. These countries include Algeria, Finland, Germany, the Netherlands, Sweden and the Yemen. All of their PTT's evaluated models from manufacturers worldwide and Beckman Industrial's meters were found to be superior to any competitive offering.

In defence, instruments have been supplied to the Dutch marines, the Finish airforce, the Swedish navy and Britain's Royal Air Force, the latter ordering the heavy duty HD110 multimeters. These meters, which meet NATO standards without modification, were the first true handheld meters to be used by the RAF. They were selected following a thorough evaluation of several manufacturers' multimeters, and are being used throughout the world in extremely rugged environments. They now have NATO codification which makes them available to any branch of the armed forces without the need for individual evaluation procedures.

On the commercial front, too, the company is a world leader, a typical example being the supply of meters to countries including Belgium, France, Spain and Sweden for use by computer, photocopier and general office equipment service engineers.

Foremost among Beckman Industrial's instruments are digital multimeters – handheld (high-accuracy Professional and low – cost Circuitmate models), bench top and heavy-duty meters, the latter being designed for use under very extreme environmental conditions.

An oscilloscope, function generator and counter are also featured in the range of instruments, as are clamp-on multimeters, logic probes and a digital capacitance meter. An extensive range of accessories is available for all the instruments including high-voltage test probes, RF probes and temperature converters.

One of the latest product lines is a range of breakout boxes for tracing faults in communication lines between computers and peripherals.

The company's Professional series multimeters comprises seven handheld and two bench/portable models.

They provide the engineer or technician with a maximum voltage rating of 1500 volts DC and 1000 volts AC. Special features include a battery life up to 2,000 hours on hand-held models, and 12,000 hours on the bench/portable models. Every model except one features Insta-Ohms Quick Continuity which signals continuity within milliseconds. The single rotary function/range selector switch on each multimeter has a special patented design that eliminates friction wear for years of continued use.

RF shielding prevents stray signals from affecting readings and the 22 Megohm input impedance of the meters reduces circuit loading to provide accurate measurements.

Overload protection includes up to 6 kV transients for 10 microseconds on all voltage ranges, and 600 volts on resistance ranges.

The Circuitmate series of digital multimeters offers a wide range of features and are excellent value for money. Five new meters have recently been added to this series which also includes the model DM73 autoranger, the smallest probe-style meter on the market and the DM800 and DM850 4-digit models, the latter having true RMS.

The new meters are the pocket-size DM10, DM15B and DM20L, for applications including computer and electronic equipment servicing, research and development,education and domestic use, and the full size, feature-packed DM23 and DM25L which can double as bench instruments.

The range of five heavy-duty handheld multimeters provides reliable, dependable performance under rugged industrial and field service conditions.

The 9020 20MHz oscilloscope

All HD multimeters have a maximum voltage rating of 1500 volts DC and 1000 volts AC, and an input impedance up to 22 Megohm.

Special features of the HD multimeters include up to 2,000 hours of battery life, Insta-Ohms Quick Continuity check, and a diode test function for accurate measurements of forward voltage drops across diodes and transistor junctions. Each meter has RF shielding and a multiposition tilt bail.

The Model 9020 oscilloscope is a compact, dual trace 20MHz instrument, which incorporates a sweep delay to facilitate waveform analysis, a feature usually only available on higher bandwidth oscilloscopes.

The built-in component tester makes the 9020 both an oscilloscope and a component curve tracer. This function gives the user fast good/bad indication of resistors, capacitors, inductors, diodes, transistors, transformers etc. The testing can be done on components both in and out of circuit.

Scopemate 2 is an integrated circuit and component tester for fast and easy testing of in-circuit and out-of-circuit electronic components. Designed for use with any two-channel X-Y type oscilloscope it can be used for testing DTL, TTL and CMOS ICs, op amps, comparators, optoisolators,PLAs, diodes,transistors, capacitors, indicators and resistors.

Beckman Industrial's universal counter is the UC10, a feature-packed, highly accurate universal counter that measures frequency,period,frequency ratio of input channels, time interval, and unit count. With its wide 100MHz frequency range can be selected functions for applications from simple counting, general audio and computer servicing, cordless telephone repair, and function generator calibration.

The function generator is designated model FG2. This instrument is capable of producing signals in seven ranges from 0.2Hz to 2MHz. It is especially beneficial for applications such as testing vibration, servo systems, general audio systems, ultrasonic devices, and AM radio alignment.

Breakout boxes are handheld instruments used to trace faulty communication between processors or control devices and system peripherals.

Communication problems can appear suddenly in any size of computer from large mainframes to small personal computers sitting on a desk. It is a fact that a large percentage of service problems involve the communications between the computer or terminal or some other device such as a printer or modem.

The breakout box is used to monitor RS232C serial communication signals. It is equipped with connectors and indicators that are configured for the RS232C communication protocol,a standard of CCITT V.24.

A lot of time can be saved by using a breakout box as a routine first step whenever the problem seems to involve a serial communication line. For example, if there are operation difficulties between a computer and a serial printer, or between a host/controller and data entry terminals, or between a terminal and a modem.

In such cases, by far the most common symptom is simply that nothing is happening, or the system may have crashed suddenly and can't be brought back up. Sources of these problems usually come down to a missing signal that indicates the "ready" status of one of the devices. So, transmission is halted indefinitely while the other device waits for a signal that never arrives. If the pattern of communication on specific pins is known, and if a test for a signal can be made on each pin of each device, it can be quickly determined if there is a problem anywhere within the interface. That is what a breakout box helps do.

Beckman Industrial offers an extensive range of breakout boxes, to meet any application.

Many of Beckman Industrial's instruments have been omitted from this short article. However, for further, more detailed information on the test and measuring instruments available, contact your local distributor or Dave Whitelaw, Beckman Industrial Ltd, Temple House, 43-48 New Street, Birmingham B2 4LJ. Tel: 021-643 8899. Telex: 33957). Fax: 021-631 2167.

Five Circuitmate multimeters

OUR PRE-EMINENCE IN INSTRUMENTS BEGAN IN A LEMON GROVE

Our reputation for precision instruments began over half a century ago when Dr Arnold O Beckman designed a pH meter to measure the acidity of lemon juice.

After which came a steady stream of advanced technology instruments which won acclaim in science, medicine, industry and education.

Today's range of instrumentation still leads in quality and value. Foremost among them are our digital multimeters – a wide range of bench, hand-held and heavy duty meters used in laboratories, factories and in the field. And our oscilloscopes, used in education, research and development and by service engineers and hobbyists throughout the world. Among our latest products is a range of break-out boxes for tracing faults in communication lines between computers and peripherals.

All packed with attractive features at a most attractive price. It all seems a long way from a lemon. But whatever their function, our products have always passed the acid test.

Beckman Industrial

Beckman Industrial Ltd.
Temple House, 43-48 New Street,
Birmingham B2 4LJ.
Tel: 021-643 8899. Telex: 339576 MIDCEN.
Fax: 021-631 2167.

PAXNET - THE DANISH ISO - OSI NETWORK

PAXNET is the name of an advanced communication service which is available to the public in Denmark.

The development of **Paxnet** was initially started in 1979 in a joint venture between the Danish Telephone Administrations and RC Computer.

Paxnet is designed within the general framework of the ISO reference model for open systems interconnection and in strict adherence to international standards whenever possible. As the name implies, the network belongs to the packet switching family. The first phase of the project therefore naturally included an initial network service with an X.25 access interface. The service is internally based on a high efficiency datagram type packet switching network.

Services

Some of the most important services offered by **Paxnet** are described below.

X.25 Service

The most internationally widespread interface between user equipment and a public network is the X.25/3 recommendation from CCITT.

Paxnet provides the X.25 service. Furthermore, **Paxnet** observes all recommendations belonging to the 'X.25 family', X.1, X.2, X.75, X.3, X.28, X.29 and so on. Thus **Paxnet** fulfils the CCITT demands of a public network.

Terminal Service

Perhaps the most important task for a data communication network is the ability of connecting user terminals and host computers.

Each terminal type, which is able to connect to **Paxnet** may with a single command choose among the connected hosts. Currently the following terminal protocols are supported thus covering a very high percentage of existing terminals:

3270 BSC;
ECMA 48 (including VT100);
Asynchronous ('triple X' and a simple virtual terminal protocol).

Specific host interfaces have been implemented for the following terminals:

IBM 43X1 and 308X;
CDC Cyber;
Honeywell Bull DPSS;
RC8000;

The specific host interfaces are connected at layer seven of **Paxnet**, if not using the X.25 service.

Naming and Addressing

The users of **Paxnet** are identified by names, called titles. This is different from pure X.25 networks, where numbers following the CCITT X.121 recommendation are used.

The titles in **Paxnet** are not tied to a physical address. This means that terminals and users do not need to know about an application being moved from one host to another.

Network Management

The **Paxnet** network management system service offers a number of tools for monitoring the network, controlling the service of the network, expanding the node capacity, installation of new terminals, adding new trunk lines, and so forth.

Future development

Paxnet is under permanent development. Scheduled new services are as follows:

ISO presentation layer — ISO
FTAM — file transfer;
CCITT X.400-series message handling;
Local area network;
SNA/SDLC gateway;
New terminal protocols.

The development and maintenance is eased by using a high level language 'Real Time Pascal' for all of the software. The software runs on a specially designed high performance communications controller, RC3502.

Computerized Services for all the worlds Teleadministrations

- Computerized Directory Assistence Systems
- Packet Switching Networks
- Networks for Value Added Services
- Alarm Systems

RC Computer

The Telecommunication Division

19, Klamsagervej
DK-8230 Aabyhøj, Denmark
Telephone: +45 6 25 04 11
Telex: 64 169

ISKRA

ISKRA is the largest company in Slovenia and the leading electronic and electrical manufacturer in Yugoslavia. In 1986 its 35,000 employees created a total income of 535 thousand million dinars and 236 million dollars worth of exports, of which 150 million dollars came from hard currency markets. ISKRA generates 10 percent of the exports from Slovenia and about 2 percent of the national total, ranking as the third largest exporter.

The ISKRA organisation is made up of 18 production divisions and seven administration divisions. These latter perform functions of common importance in areas such as commerce, finance, organisation, along with other activities vital to the smooth running of a large system. ISKRA commerce, which is the common regional marketing organisation, contains a network of 25 foreign representative offices, retail shops and plants, all over the world. In Yugoslavia, ISKRA has developed a network of subsidiaries, business and servicing centres.

ISKRA has the highest level of investment in research and development in this sector of industry in Yugoslavia. Through such investment and through intensive co-operation with other technological research resources at home and abroad, ISKRA keeps pace with the most advanced trends in electronics, telecommunications and computing, as well as in state-of-the-art electronic and electromechanical components and assemblies. To achieve this goal, ISKRA gives priority to investment, not only in materials but also in personnel and their training.

ISKRA's main activities comprise the production and distribution of advanced electronic and electromechanical components, assemblies, devices and systems in telecommunications, computers, optoelectronics, automation, measurement and control, cybernetics and robotics, automotive electrical equipment and consumer products.

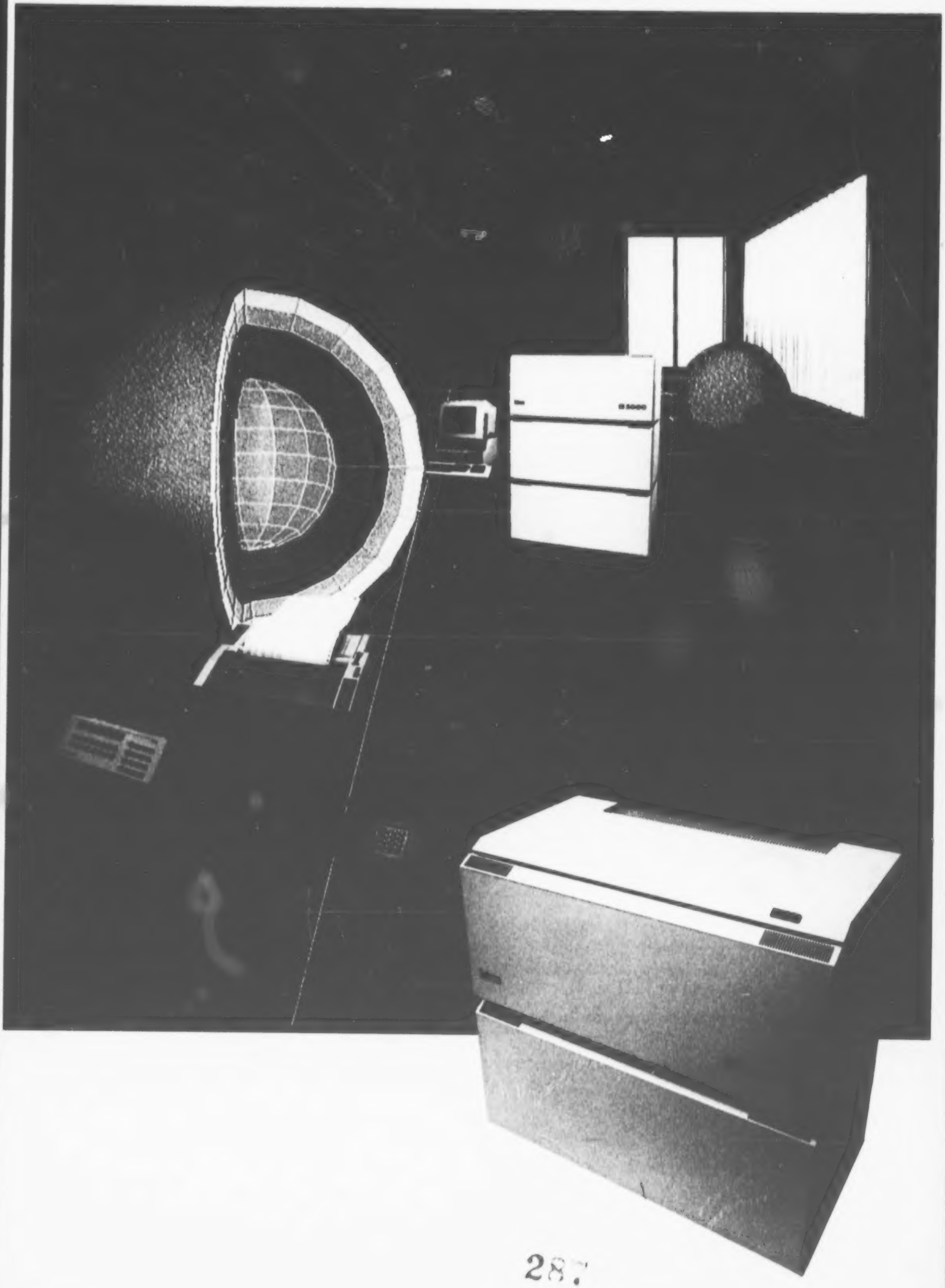
In all these market sectors ISKRA is supported by its proven expertise in specific technolgies, particularly in the field of microelectronics. With this broad range capability ISKRA is active in all forms of international trade and technical co-operation.

Microcomputer-based technology is the basis not only of successful development in industry, social activities, defence and education, but also in culture and entertainment. In this area, constant growth of several percent per year in the domestic and foreign markets is characteristic. ISKRA's products are cost competitive with regard to energy and material investment, sophistication and quality.

The global electronics market has seen rapid technological development, and two factors are significant. First, the swift penetration of electronic devices and systems into increasingly specialised application areas, and second, the increasingly strong technological integration of modern systems with other technical disciplines in other fields. ISKRA's key advantage is that it combines different types of manufacturing and technolgical expertise, ranging from individual components to highly complex systems, from mass production to custom design and engineering activities. ISKRA is also active in key production fields where the highest standards are required to meet the exacting demands of advanced data processing and other systems. This development and production capability in vertical as well as horizontal links, is the basis for ISKRA's further successful development and continued product advancement.

ISKRA's main product ranges cover the following fields: telecommunications and data processing; automation; measurement and control equipment; components; automotive electrical and electronic equipment; household appliances.

□



WORLDWIDE COMMUNICATIONS BY TELEX

ATS TC2020 TELEX/DATA TERMINAL

Using the very latest in ergonomics the TC2020 has been designed with simplicity of use in mind with easy-to-follow menu-driven programs to minimise the training your staff will need.

// Minimum operator activity

// Many destinations with one simple operation

// Frequently used numbers stored in memory

// Automatic redialling until connection made

// Growth capability from 64 Kbytes – 265 Kbytes

// Optional IBM PC compatible interface

// Operates from normal 110/240V ac supply

// ASCII (ITA5) or Baudot (ITA2) line options

// Automatic battery back-up power supply

// Installations in use worldwide with full technical support

ATS AUTONET MESSAGE SWITCH

The Autonet message switching system is the first choice with businesses that handle a busy telex traffic and communications network.

// Solid state memory

// Up to 40 lines per system

// Operates any line mix – telex, telegraph, voice grade data, packet switch stream and Teletex

// 256K-768K characters of library/traffic memory

// Operates from normal 110/240V ac, or 50V dc supply

// ASCII (ITA5) or Baudot (ITA2) line options

// Automatic battery back-up power supply

// Options – 20/80 Mbytes on Winchester disk storage, detachable memory for archiving

// Installations in use worldwide with full technical support

ATS – WIDE PRODUCT RANGE

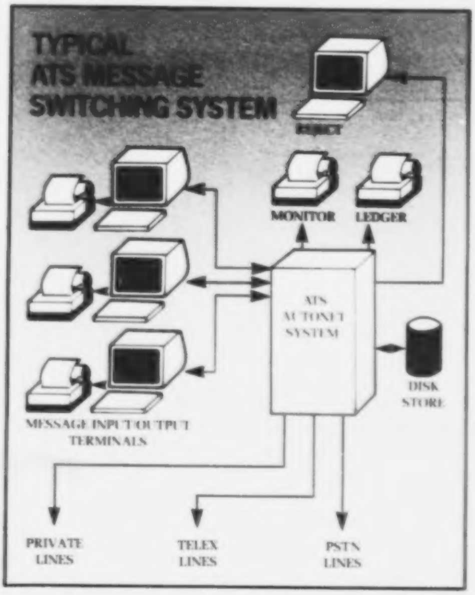
Our range of products runs from desk-top telex terminals to full message switch systems. They are built for three-way growth – to link with existing office electronic equipment, to link with communications networks of the future, and to link with more telex lines, printers, etc, as a company expands.

Our message switches include features that are not usually found on other systems. They are the only ones considered reliable and robust enough for use on North Sea oil rigs, thanks to a solid state memory, replacing the usual floppy system. Our medium size message switches – with up to 40 lines – mean our customers only pay for the intelligence they use.

With total integrity for message-protection, these message switches hold up to 750,000 characters in solid-state memory and up to 80 million characters for long-term storage, and are the choice of many major companies who depend on reliable yet flexible telex communications.

Smaller desk-top message switches with up to ten lines for telex, printers VDU's etc also incorporate the same state-of-the-art technology.

Our range also includes a unique 'gateway' system – a desk-top processor box giving electronic office products direct access to the telex network, plus telex management capabilities. Used by other manufacturers to effect gateways to their own systems, this unit is ideal for small businesses who do not want the expense of buying a terminal but need access to the telex network. Like all the other products in our range, it is designed to link straight into the new communications networks as and when they become operative.



Adding a telex management module to a terminal provides a full message management capability in a desk-top unit. That means messages prefixed with a simple instruction are automatically sent to a preselected list of addresses, stored in the unit's memory, held up till night to catch cheap rates or to reach another continent in office hours, stored indefinitely until needed, or follow a multiplicity of other commands.

Our message preparation terminals enable anyone to prepare and send text from their desk-top unit. Other manufacturers make desk-top terminals, but our terminals have a spare port for teletext or packet switching, and allow a print option – dot matrix or typescript, serial or parallel.

ATS TELEMETRY SYSTEMS

Computer systems
// (SCADA) Telecontrol systems
// Network monitoring systems
// Airport ground control lighting systems
// Security alarm handling systems

Products
// Outstations
// Central control stations
// Modems
// S and DX systems

Communications
// Private wire and PSTN
// Microwave
// Radio
// Fibre optic

Applications
// Water, Sewage, Gas etc
// Communication Systems
// Electricity Supply Industry
// On/Off Shore Oil Industry

Telemetry enquiries phone (044 444) 417531

Further information on the ATS telex terminal and message switching range is available from:

ATS
COMMUNICATIONS

ATS Communications Limited.
Burrell Road, Haywards Heath,
West Sussex RH16 1TP England
Telephone: (044 444) 414911
Telex: 877134 ATSLTD G
Fax: (044 444) 412961

TEXT COMMUNICATION:

TELEX: TX 35E.

Pioneer, world leader, SAGEM is again on the edge of innovation in 1987 with its new range of telex terminals: TX 35E, 4 versions + interfaces, from the most cost-effective to the most sophisticated.

The key word is modularity. different screens, storage capacity, serial port for computer to be connected to telex network, punch and reader module and a 3"½ disc.

Every second minute one telex machine leaves SAGEM factories.

TELETEX: TCX 2000.

Electronic mail for the future available today. SAGEM teletex terminals offer 3 mains functions:

- Access to the international TELETEX network.
- Access to the international TELEX network.
- Professional word processing easy and simple to handle.

All models of the SAGEM range with either 2 disc drives or with one disc and one 10 MByte hard disc, depending on the traffic and the amount of documents to be processed.

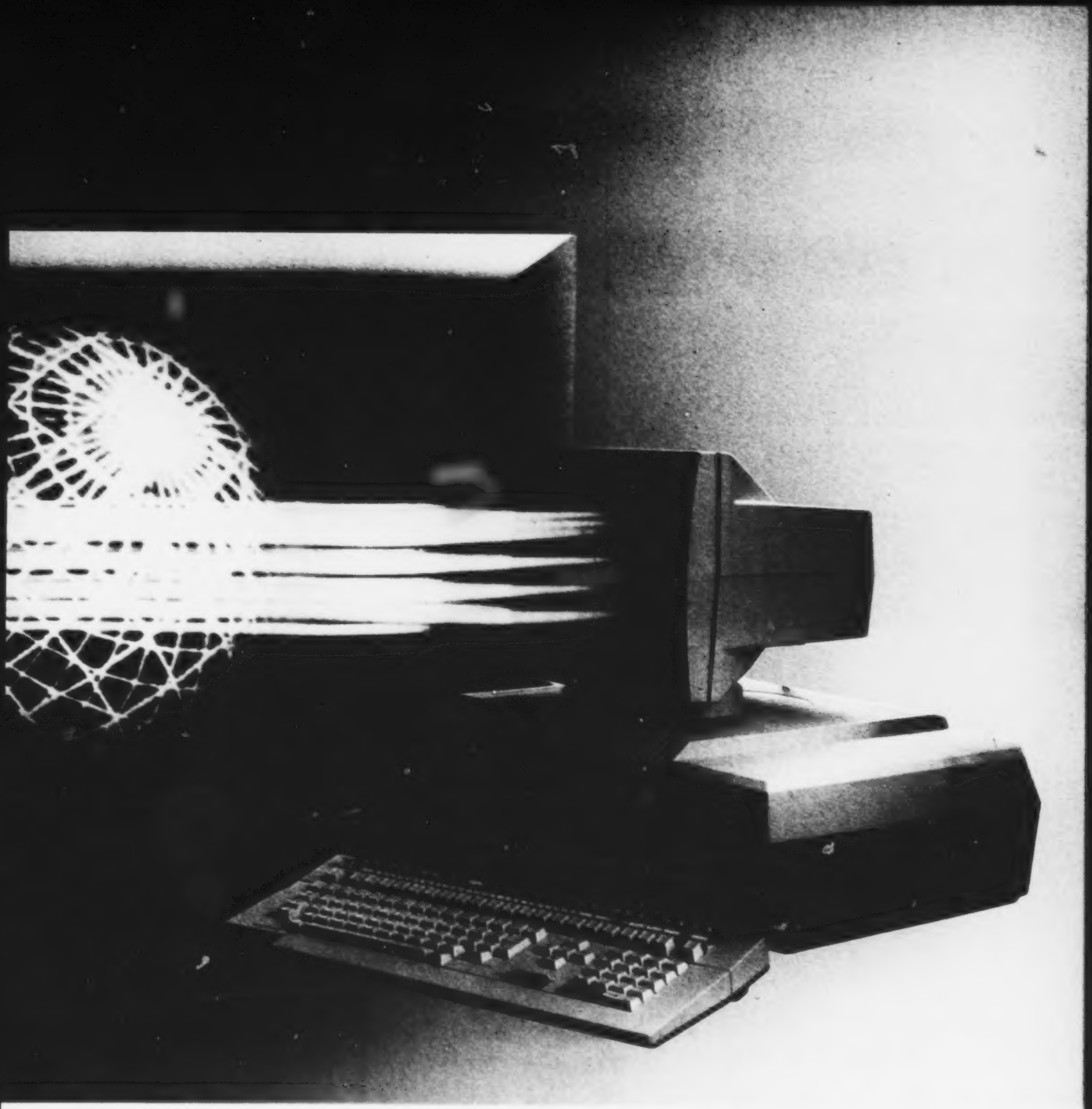
TELEX MESSAGE HANDLING SYSTEM.

A range of telex message handling system allowing, from PC or videotex terminals, transmission, reception, filing as well as selection and re-routing of telex messages.

TRANSTEX SAGEM telex message handling system are more specifically for companies with high telex traffic, whishing to decentralise this function and to render it available to a maximum of users. They are, the more often as an addition to specialised and centralised services.

SWITCHING SYSTEMS: ELTEX V.

The modular ELTEX V switching systems for telex network manufactured by SAGEM will always offer a custom-tailored design. From a few dozen to a few thousand suscribers, ELTEX V are operational in more than seventy countries.



All these products are distributed and maintened by SAGEM with 15 subsidiaries, joint ventures or companies working under licence, along with 165 representative offices in 90 countries.

SAGEM: COMMAND OF HIGH TECHNOLOGIES.

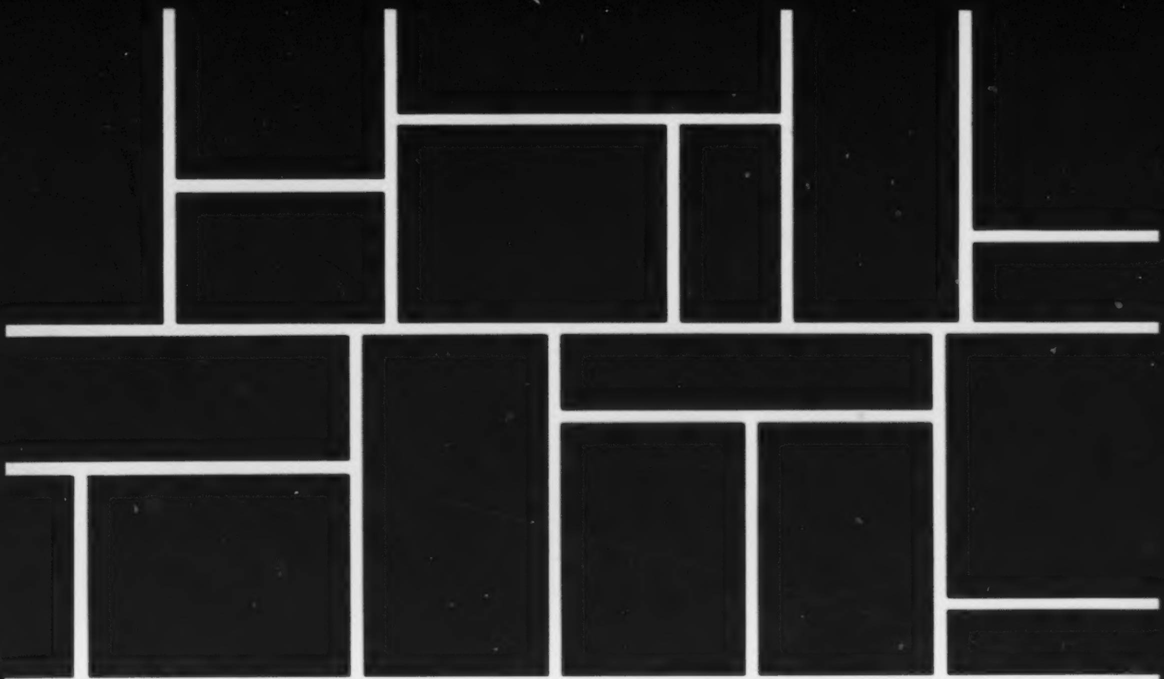
World's first manufacturer of V.D.U. telex terminals. Europe's first manufacturer of inertial navigation systems,as well as the european manufacturer of bubble memories.

RESULTS.

SAGEM is a French Company (S.A.) with French capital.
In 1986, its turnover amounted to 4,472 million francs, this represents an average 19% increase per annum for over the past 10 years. It has achieved exports of 1,035 million francs. A quarter of its total activity was exported in 1986, to 113 countries.

SAGEM

TELEX AND OFFICE AUTOMATION DIVISION
6, avenue d'Iéna, 75783 PARIS CEDEX
Tel.: + 33 (1) 47 23 54 55 Telex: 614528 F
Teletex:933 - 142912370 = SAGEM TB



ALL THE BLACK BOXES ON EARTH CAN'T COMPETE WITH ONE DATA COMMUNICATIONS COMPUTER FROM JUPITER.

The first computer designed exclusively for data communications ☐ Combined hardware/software solution for total systems integration ☐ Communications oriented operating system provides maximum flexibility ☐ Modular software functions facilitate fast, efficient implementation ☐ Expandable multiprocessor design for growth ☐ Modular, user-programmable design allows expansion without reprogramming ☐

Jupiter
TECHNOLOGY

SOLVING INCREASINGLY COMPLEX COMMUNICATION PROBLEMS

Data communications products and capabilities have not kept pace with the increased utilization of computers and demand for electronic information transmission. This has led to a growing need for integration technology that is not being met by traditional data communications products.

Today's data communications products are typically single function solutions that address only small pieces of the problem. They are hardware oriented, inflexible, and have limited functionality. Implementation of complex systems requires multiple units such as protocol converters, multiplexers, and switches. Integration is difficult and expensive.

Further, these systems are often [illegible] and, as requirements change, new units must be added and the system continually rebuilt.

Increasingly, software-based solutions are being employed to accommodate custom solutions and environmental flexibility. These solutions most often run on general purpose computers which are both difficult to program and inefficient because they are not designed for data communications tasks.

The Jupiter Technology System 1000 is the next important step in data communications product evolution. Designed specifically for data communications, it offers the cost/performance of hardware solutions and the flexibility of software solutions. By combining a proprietary communications operating system known as Softlink, modular communications software, and expandable multiprocessor hardware, JUPITER TECHNOLOGY has created a foundation for total data communications system integration.

THE JUPITER TECHNOLOGY SYSTEM 1000

The SYSTEM 1000 is a modular multi-processor system containing up to 14 MC68000 processors and multiple port connection boards. Capable of handling up to 224 lines, it is geared towards solving difficult communications and integration problems. The system functions as a communication processor to off-load host computers and interface dissimilar equipment and networks. It can also provide wide area networking capability and Local Area Network communication services.

The Softlink communications operating system is the heart of the SYSTEM 1000's software. As a communications resource manager, Softlink organizes and controls all of the SYSTEM 1000's communications processing.

Softlink creates Softwires, dynamic data routes that link the SYSTEM 1000's software modules, called Softblocks™. Together Softwires and Softblocks create communications processing pathways which not only transfer information from point to point, but also perform a range of processing functions. Each Softblock performs a function or implements a protocol, such as IBM 3270™ emulation, X.25 packet switching or asynchronous communications, and can be dynamically connected to other Softblocks.

Softblocks are developed by the user, JUPITER TECHNOLOGY, or third parties. To accommodate the wide variety of Softblocks and potential applications, JUPITER TECHNOLOGY has developed a unique software architecture which allows data transfer between Softblocks without affecting the functions within the modules. This modular software environment enables customization of the SYSTEM 1000, allowing integration of complex communication systems with little or no custom programming.

APPLICATIONS

The flexibility of the SYSTEM 1000's software and hardware design allows it to be used in many environments. The following represent typical applications from actual SYSTEM 1000 installations.

At a financial services corporation, the SYSTEM 1000 links remote PCs and asynch terminals with mainframe computers. Users can access, via inexpensive terminals, the full range of applications running on the host mainframes. Asynchronous Softblocks interface to the terminals and PCs, and the SNA 3274/78 Softblock makes these devices look like IBM 3278s to the SNA hosts. In addition, CCITT X.25 and packet assembler disassembler (PAD) Softblocks support packet switching networks, and the customer is writing Softblocks to permit connection to various stock quotation systems.

Another installation uses a similar SYSTEM 1000 link over 100 Wang word processing systems to IBM service bureaus via a packet switching network. This SYSTEM 1000 is configured with Wang store and forward, bisynchronous, and X.25 Softblocks. This allows financial documents to be stored in word processor format and retrieved by other systems at any time.

A third application uses the SYSTEM 1000's IBM 3270 emulation and cluster controller Softblocks to permit over 400 IBM 3270 users to access multiple IBM host computers. Here, each user is presented with a menu to select and open multiple host connections.

These installations all use a standard SYSTEM 1000. Its flexibility and functionality allows users to customize the SYSTEM 1000 to meet individual needs. All that is required are necessary port connections and Softblocks.

As the users' needs change, the SYSTEM 1000's modular design enables them to add more Softblocks and system hardware modules.

CUSTOMIZATION

Every computing and data communications environment is unique. The SYSTEM 1000's modular design fits into virtually any environment. By adding hardware modules, the SYSTEM 1000's capacity can be matched to the system requirements. The SYSTEM 1000's software can also be customized in several ways, ranging from use of a Jupiter Technology-supplied interpretive communications programming [illegible] to user implementation of Softblocks from Jupiter Technology supplied templates and development tools.

Jupiter
TECHNOLOGY

JUPITER TECHNOLOGY, INC.
78 Fourth Avenue
Waltham, Massachusetts 02154
(617) 890-4555

[illegible]

MANNESMANN
TALLY

The way to your computer's heart is through a Mannesmann Tally printer

Let's be very frank: Your computer is just not interested in our company's success story, which started in 1972, and how, in 1979, we broadened our technological basis by joining forces with the American Tally Corporation, or even in our international reputation, firmly built on enormous experience and know-how, or how we run our ultra-efficient worldwide sales network. No! We are pretty sure that your computer is basically only interested in matrix, laser, and bubble ink jet printers from Mannesmann Tally!

Of course, the whole range is totally compatible, no hidden ifs and buts. With printing speeds that are hard to overtake. Producing just enough noise to let you know they are working. And the print quality? Publishing standard! Not to mention the ease of operation which will certainly impress your secretary.

All these advantages, plus superb quality and economy, have made us the largest printer manufacturer in Europe. And if it weren't for the long, long life of our printers, we could sell even more of them. For you and your computer, of course, this is just another very good reason to obtain more detailed information about our range. How? Just write us!

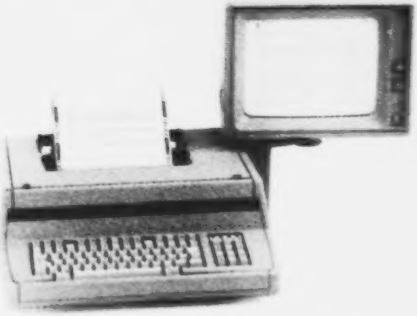
mannesmann *technology*

Mannesmann Tally GmbH
Postfach 2969, D-7900 Ulm
Federal Republic of Germany
Phone: 7308/80-1

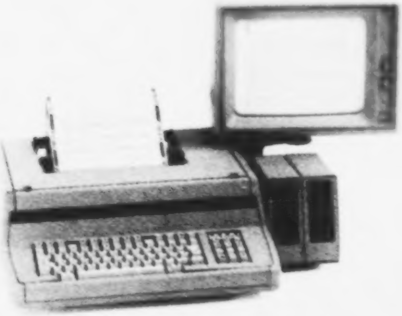
2-2883-001

NEW TELEX POSSIBILITIES with THE PHILIPS PACT 250 TELEPRINTER SYSTEM

Start by doubling telex productivity! With its very large electronic memory, powerful message-preparation functions and automatic sending and receiving, even the most basic Philips PACT 250 Teleprinter can handle twice the work of conventional machines. Enquiries are answered faster. Business opportunities are taken.



Now add a screen. For heavy telex users, text-editing on screen offers even greater speed, convenience and accuracy. Philips' latest Visual Display technology gives a large, flicker-free, black-on-white display just like a sheet of paper. It looks good, it's easy to read, and it's kind to the operator's eyes.



Now add more memory. With two Flexible Disk Units fitted, PACT 250 has an enormous on-line memory of 670 000 characters. More messages can be kept for editing and re-use; more Forms and Standard Text can be stored. And users that want a permanent record of telex traffic have unlimited archiving onto removable 3 ½-inch diskettes.

And now put Telex on *every* desk! The new PACT 250 Local Line Interface can integrate telex into general office automation. Word-processors, personal computers and memory typewriters can all have **direct** access to the worldwide telex network. Everyone can send telexes automatically and receive them on their own screen or printer.

PHILIPS

THE DEVELOPING WORLD OF TELEX

Philips led the way with the first electronic teleprinter more than ten years ago. Now, in the PACT 250, they have a Teleprinter System that covers the whole range of telex and non-telex applications, from the simplest to the most advanced.

TELEX ON EVERY DESK

A new accessory, the PACT 250 Local Line Interface ('LLI'), seems set to transform the whole world of telex. By extending the telex service to all the other electronic equipment found in modern offices – computers, word-processors, electronic typewriters – it allows incoming telexes to be received and dealt with at the right desk; outgoing telexes to be sent from any desk fully automatically.

Up to ten local terminals can be directly connected to one PACT 250 Teleprinter, the maximum distance is 500 metres. And there is no limit to the number of remote terminals that can have access to the Teleprinter via a modem and telephone link.

REMOTE SERVICING

For the PTT authorities who equip and run the public telex system in most developing countries, important features of PACT 250 will be its proven reliability in all climates, its exceptionally low servicing costs, and a set of user-features that will attract customers both small and large.

PACT requires no routine maintenance at all; and when a fault does arise, it can usually be diagnosed from the service centre without a visit – a major advantage in countries where travel may be slow, difficult and expensive. An engineer simply interrogates the terminal's own self-diagnostic program remotely via the telex line itself, and then tells the telex user which plug-in module to replace, from stocks kept on site.

ADVANCED USER-FEATURES

Some of the main user-features of PACT 250 are:

- Huge memory capacity. Internal memory is 42 kBytes minimum, expandable to 170 kBytes. One or two Flexible Disk Units add a further 250 kBytes each.
- International Typewriter keyboard. Trained secretaries can use it immediately. Editing and communications keys are kept separate.
- Simple, powerful text-editing gives the advantages of word-processing without the complications. Users can overtype, insert, delete, copy and move text; set up standard Messages and Forms. A 12-inch VDU screen is optional.
- Automatic sending to single or multiple destinations. Sending may be immediate or at a pre-set time, and includes automatic number and answer-back check, automatic re-try of busy numbers, automatic cleardown. Local editing work can continue at the same time.
- Automatic receiving. Incoming messages do not disturb local editing work but are stored and printed later.
- High-quality printout. A 12-pin head gives outstanding readability on up to five copies, and can handle non-Roman scripts.
- High speeds available. Text stored in memory prints out at 70 char/s, ten times telex line-speed. In non-telex (e.g. police and railway) networks, PACT 250 can send and receive at line-speeds up to 300 baud (ASCII).

INTERNATIONAL SALES

PACT 250 has a huge international user-base in countries as diverse as Mexico, Greenland, Indonesia, Jamaica and the People's Republic of China. The PTTs of the Netherlands, Sweden, Norway, Switzerland and Ireland have many thousand terminals in use. In other countries local manufacture or assembly is under negotiation.

A notable success in 1986 was the choice of PACT 250 for the International Conference of Non-Aligned Nations in Harare, Zimbabwe, attended by 80 heads of state and over 5000 delegates and journalists. The 200 terminals and 100 LLIs bought specially for the Conference have now gone into ordinary public service.

PACT 250 is designed and manufactured by Philips Elektronikindustrier AB of Sweden, a specialist company within the multinational Philips electronics group. It is sold and supported by Philips National Sales Offices throughout the world. Full information can be obtained from your local Sales Office, or direct from:

Philips Elektronikindustrier AB
Telecommunication and Data Systems
S-175 88 Järfälla, Sweden
Telephone: (Int.) +46 758 10000
Telex: 11505 PHILJA S

TELEX FOR THE WHOLE WORLD

PHILIPS

MODEMS AND MULTIPLEXERS... THE PRODUCTS THAT STAND FOR "QUALITY" WORLDWIDE

Since 1970, Multi-Tech Systems has been quietly emerging as the leading data communications manufacturer in the world. Today, Multi-Tech has achieved an international reputation for producing high quality and reliable products. Multi-Tech's measure of quality is the extremely low percent of products returned for repair. This lower than normal repair rate is due to extensive functional testing in controlled temperature environments under adverse conditions. These tests assure the end-user of having a quality, reliable product.

Multi-Tech Systems is a privately held U.S.A. corporation that prides itself on fostering strong employee-corporate relationships. This leads to a well balanced, committed workforce of nearly 100 persons. This committed, well-trained workforce assures an end-user that a Multi-Tech product is a lasting product.

END-USERS
Multi-Tech System's end-users are leading airlines, banks, educational institutions, governments, military units, PTT's plus many other commercial, industrial users. Each user utilizes a modem or multiplexer to transmit or receive data between mainframe and PC computers or other departments, access databases and send or receive electronic mail.

MODEMS
Multi-Tech modems are designed to be easily connected or plugged into a PC computer. The internal modems are the simplest approach to data communications for end-users, along with our external/desktop modems. These intelligent modems connect your PC or terminal to the telephone lines, and connect you to the online world.

MULTIPLEXERS
For those end-users who currently have numerous modems, asynchronous communication lines and who have plans to extend their data communications network, Multi-Tech offers them a four or eight channel statistical multiplexer. This device controls rising communications costs plus adds network security to your data communications.

Multiplexers combine up to eight (soon sixteen up to thirty-two) asynchronous, dial-up lines between two common locations. These locations can be data or graphic terminals, serial printers or PC computers. By combining these lines into a single, cost-effective synchronous/leased line, you achieve a more secure network, free of errors at a reduced cost.

THE FUTURE
Multi-Tech offers a commitment to its end-users. A commitment of producing high quality data communications modems and multiplexers. This committment has not changed since 1970. Multi-Tech products are, now more than ever, a wise investment for your future.

Written by: Dan Bucholz

MultiTech
Owner's Manual

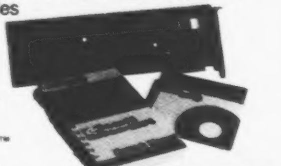
Modems, Multiplexers and Much More, from Multi-Tech Systems:

The right products from the right place, at the right price.

Data communications is now the fastest growing segment of the computer industry, and Multi-Tech Systems is one of its fastest growing suppliers. We've been building modems in the U.S. since 1970, and are now one of the leading modem, multiplexer and terminal emulator manufacturers in the world today.

300 bps Modems

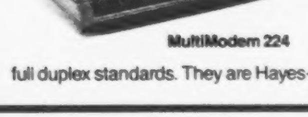
- The **MultiModemV21** desktop modem and **MultiModemPC21** internal modem provide 300 bps communications over dial-up phone lines. These autodial/auto-answer modems are both CCITT V.21 and **Hayes** "AT" compatible. The internal modem includes MultiComPC communications software.



MultiModem 224EC

1200 bps Modems

- The **MultiModemAH2** desktop modem is V.22 and V.21 compatible. MNP™ error correction is optional. The **MultiModemPC3** internal modem is V.22 compatible. Both modems operate at 1200/300 bps, Hayes compatible, with autodial/auto-answer and a phone number memory. Software is included with the MultiModemPC3.



MultiModem 224

2400 bps Modems

- The **MultiModem 224** and **MultiModem 224E** operate at 300 1200 and 2400 bps, and are compatible with the CCITT V.22bis, V.22 and V.21 full duplex standards. They are Hayes-compatible asynchronous and synchronous, and provide automatic dialing and answering, with a ten number memory. The MultiModem 224E features MNP™ error correction, which gives you 100% error-free data transmissions, even over bad phone lines.
- The **MultiModem224PC** and **MultiModem224EC** are the internal IBM-PC card versions of the MultiModem224 and MultiModem224E, and include our MultiComPC™ software.

9600 bps Modems

- The **MultiModemV29** is our newest modem, and operates at 9600 and 4800 bps. It is CCITT V.29 compatible, synchronous, and operates over full-duplex four-wire leased lines. The MultiModemV29 can also run in the asynchronous or synchronous mode over dial-up lines.

Statistical Multiplexers

MultiMux

- **MultiMux** statistical multiplexers reduce line expenses, improve network security and eliminate data transmission errors. They are very flexible, and are extremely easy to install and use.
- The MultiMux is offered in four- and eight-channel versions, with or without an integral 9600 bps V.29-compatible modem. It includes a supervisory port, help menus, downline loading, full LED display, statistical reporting, and an integral 1200 bps dial-up modem for remote configuration and diagnostics.

3270 Terminal Emulators

MultiCom 3270

- Multi-Tech Systems' newest product offering is the **MultiCom3270** Terminal Emulation System. It includes an internal PC-to-mainframe coaxial card and software, and allows an IBM® or compatible personal computer to function as an IBM® 3278/79 terminal.

Multi-Tech data communications products are the choice of business, banking, government and educational users worldwide . . . get the right products at the right price, from Multi-Tech Systems.

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OTC — COMMUNICATIONS CONSULTANTS TO THE WORLD

OTC is Australia's international communications carrier, responsible for the planning, establishment, maintenance, operation and development of telecommunications services between Australia and other countries.

Australia may have a relatively small population of just over fifteen million people, but OTC is one of the largest telecommunications operators in the world.

Through voice, data, text and video services, OTC offers one of the most extensive communications networks of any country in the world, and Australia is fast becoming the communications centre of the Asia/Pacific region.

For many Japanese, European and United States corporations, Australia has special appeal as a communications hub. The country's modern business practices, stable government and economy, and its world standard communications facilities means that many international corporations are using Australia as the hub for their Asian and Pacific operations.

Employing the latest in modern digital technologies, OTC has developed a highly sophisticated international telecommunications network.

Including an elaborate network of three international gateways, four satellite and four cable communications stations, as well as 13 maritime radio stations strategically placed around Australia's coastline, OTC keeps Australians in touch with the world, and vice versa.

Today, for many corporations, communications are the lifeblood of economic success. Without efficient, speedy and effective communications, many corporations cannot hope to be competitive.

To succeed in this new business world, it is essential that companies have reliable and secure communications links to markets and customers overseas.

The expertise needed to create such links is not immediately available within most businesses. This is where the OTC Communications Consultants step in. Their role is to analyse, plan and even install communications facilities.

It is not enough for OTC to simply provide communications services. The company also likes to work in partnership with their customers to identify current and future telecommunications requirements and provide solutions to their individual needs.

OTC's Communications Consultants have a proven track record both within Australia and overseas. Already these consultants have solved communications problems in some remote locations.

By erecting a Vista dish inside a protective radome, OTC has also provided satellite communications to Davis, one of Australia's research bases in Antarctica, making Australia the first country to establish sophisticated communications links to this remote area.

The radome shields the Vista dish from the harsh Antarctic environment and can withstand winds of up to 300 kilometres per hour, yet allows communications signals to pass through unhindered.

Now the people at Davis not only have the benefit of faster and more efficient communications systems to transmit important meteorological and scientific data to Australia, but these improved communications links also help to ease feelings of isolation.

Over the next two years, OTC will install Vista dishes at three other Australian Antarctic research bases.

Another 'first' for OTC will occur later this year, when OTC installs a Vista dish in Ho Chi Minh City and establishes a direct satellite communications link with Vietnam. This earth station will provide high standard telephone, telex and data links with Vietnam.

OTC is the world's sixth largest user of Intelsat satellites networks and the third-largest owner of cable systems. Their high-capacity digital satellite networks, laser-driven optical fibre systems and broad range of specialist services, ensures that OTC meets the specific communications needs of individuals and businesses.

In April this year, OTC launched a new Corporate Identity programme, including a new logo, and business approaches.

Their new corporate message 'No one's far from Anyone Anymore', is a statement of fact. OTC is fully capable of assisting social and business users alike to keep in touch with the rest of the world — quickly, conveniently and economically. ☐

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Australia has become the information hub for the SE Asian and South Pacific regions.

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Information that is readily available to you with the help of the OTC Australian Database Directory.

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OTC 0130 Mojo•MDA

Easy does it...

GN Netcom A/S – an independent limited liability company – forms part of the Great Nordic Group, based in Copenhagen and comprising 42 companies working in the field of telecommunications, electronics, electrical engineering and information technology. Thirty GN companies are located abroad – in Europe, North America and the Far East.

The Great Nordic advance in headset technology... light as a feather – less than 30 g!

In the not so distant past switchboard operators had to sit and suffer all day long – carrying rather than wearing a contraption that looked like an upside down hunting horn. Fortunately, new lightweight materials and micro-electronics have made life a bit easier for operators.

Today's headset – the Stetomike developed by GN Netcom – is gossamer light. Well, it weighs about an ounce – or under 30 g, if you prefer metric. So light and so easy to wear that you may very well forget that you are sporting your slimline Stetomike!

We put the focus on comfort, efficiency and adaptability when developing the new headset. And Great Nordic is no novice when it comes to acoustics technology – we have been developing and producing telecom equipment for over 45 years. So it is not so surprising that the GN research and development team has come up with another winner – combining advanced design with hitec performance. Clear as a bell – that is how your voice comes over with the Stetomike!

For Sheer comfort – the Stetomike 808...

Comfort is important, but it is very often a matter of personal preference. The Stetomike 808 range – a triumph of Scandinavian design – lets you choose the set that is right for you. You can choose between single-ear or two-ear reception. And whatever set you choose it is going to fit well, look good and function perfectly in any telecom environment. Make the perfect choise for sheer comfort – the Stetomike 808.

For freedom and flexibility – the Stetomike 900...

If you insist on a headset that you can adjust as you please, to match your mood or your new hairstyle, choose one from the Stetomike 900 range. What is more, you do not have to bother about wearing components – even tiny ones – in your ear. And you get the same advanced GN telecom technology, design and comfort. We tried a lot of headsets on a lot of heads when developing the Stetomike 900 – the ergonomic headset that gives you total freedom and flexibility. If you meet an off-duty operator wearing a headset, it is probably a Stetomike 900 – so exactly right that he has forgotten that it is there.

Worldwide service – the Stetomike network...

Stetomike headsets are worn all over the world – in public telecom centres, in offices, factories, hospitals, hotels, traffic communication centres – by users who insist on comfort and efficiency. And reliable too, backed by the worldwide Stetomike service network, which deals promptly with any problems that may arise.

If you would like to know more about the new Stetomike range of headsets, please get in touch with GN Netcom.

Stetomike 900

Stetomike 808

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than 25 o[illegible]al approval
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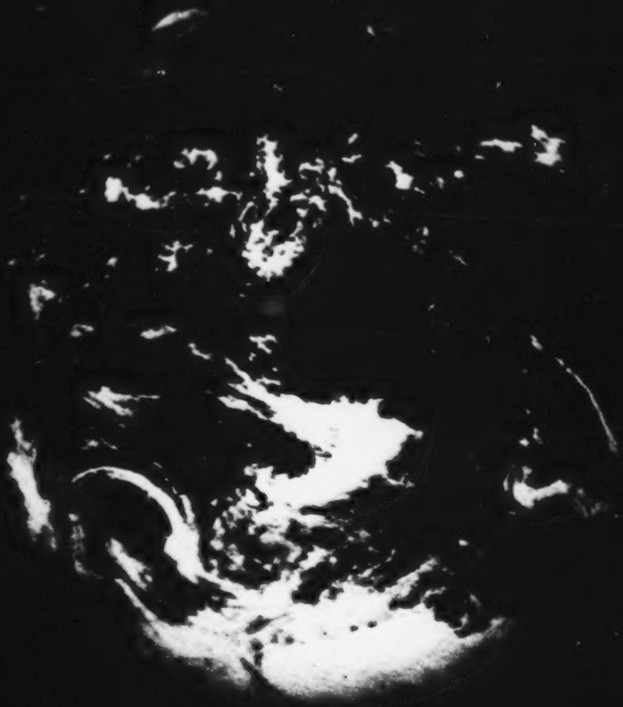

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OPERATIONS AUTOMATION:

WANG AND THE NEXT PHASE FOR OFFICE COMMUNICATIONS

MANY different 'islands of technology' have evolved within companies, due to the lack of effective interaction between them, and of effective communication with the outside world. Operations Automation, or the use of computer technology to enable people to more effectively attain their stated business goals, has helped to dissolve these islands. Companies such as Wang are now providing both the physical and relational links to allow technology to be used more effectively.

The manner in which information is presented to each user is as much a part of the communications world as standards, networking and telecommunications developments. Wang calls this sector of the communications link, 'presentation services; and its importance is clear when one considers the variety of data functions a typical corporate user performs across a range of different applications. A company may have IBM systems for its mainframe functions, DEC minicomputers at a departmental level, and a variety of stand-alone PCs and word processing or accounting systems. If each system is independent of the others, then, after manipulating his information a user can do little more with his data. Wang's concept of presentation services ensures that each separate system can communicate with others through a standard interface, and with the outside world.

When Wang first defined the six technologies of office automation — text, data, voice and image processing, in conjunction with networking and human factors — it laid the guidelines for the emergent integrated information processing market, which required the merging of the separate technologies of distributed office systems, data processing and communications. The company's VS minicomputer range, with its ability to provide data processing, word processing and office automation in an integrated environment, enabled it to become a leading supplier in the rapidly developing hardware and networking marketing.

Total Business Solutions

As one of the world's Top 10 Computer manufacturers, Wang might have been expected to consolidate its achievement and concentrate on refining its technology to provide an exclusive corporate processing environment which would only admit other vendor's equipment with difficulty. Recognising, however, that the future of the computing industry lay in integrating the vast array of complicated and incompatible products to provide customers with total business solutions, Wang became one of the first to declare its dedication to co-existence with other manufacturers' equipment, particularly the IBM environment.

Wang's commitment to the unification of the multi-vendor environment can, with hindsight, be seen as a natural response to user requirements and a simple reflection of the wishes of the corporate computing marketplace. But its early decision to address the key user concerns has been a major factor in its emergence as a leading worldwide computer company in its own right. The company has invested heavily in departmental data processing and communications technology, and continues to invest in the future through its commitment to OSI, Open Systems Interconnection. This is why it is currently able to deliver Wang systems co-existence and connectivity with other major manufacturers' equipment.

Over the past few years, Wang has announced a series of communications products and services under its Wang Systems Networking protocols, which have gradually bridged the gaps between itself and the IBM and DEC environments; IBM cabling, Wang Office 2.0, the incorporations of IBM PCs into Wang networks, further advances in Wang integration with DISOSS and PROFS, and the implementation of SNA between Wang and IBM. These have all shown IBM users that benefits such as Wang Office presentation services no longer have to be exclusive to Wang users.

In addition, implementation for the DEC world of VT100 and IEEE integration under Ethernet 802.3, enables corporations with IBM mainframes and DEC minicomputer systems to integrate their corporate processing environments. Features such as the Local Interconnect Option, which enables PC users to access the added value services obtainable through Wang VS minicomputers, and its OIS systems, ensure that companies can, in one framework, lay down the basis for a corporate system which can give them the freedom to maximise their profitability.

Office Automation

A major plank of Wang's current office automation solution is Wang OFFICE, mentioned earlier. Wang OFFICE provides both a users' applications gateway, and functions as an application in its own right. It offers word processing, mail and messaging, calendering, personal telephone directories, database facilities, and other features.

Wang OFFICE is the vehicle for presentation services, but for Wang to be the foremost provider of presentation services, the company has to provide users with gateways to their own information worlds irrespective of their environments. Wang's commitment to this philosophy is demonstrated by the OFFICE DISOSS and OFFICE/PROFS gateways which have already been announced to the IBM world. In addition, Wang's strengths in networking are currently unparalleled. Links to SNA LU6.2, API, Token Ring and SNADS, and a commitment to the ISO's open systems interconnect OSI standard, all show the company as ideally placed to draw together the disparate elements of corporate computing.

The Multi-Vendor Environment

Wang Systems Networking provides an overall data communications and networking framework both with a 'Wang-only' and with multi-vendor equipment and networks. WSN is evolving into an open communications architecture that will be compatible with the ISO OSI open systems interconnection standards. Wang is soon to announce X.400 message handling support, opening up message handling facilities to such users as those with 3270 compatible workstations.

Wang is also committed to establishing WITA — Wang Information Transfer Architecture — as an international de facto standard. Presently there are over one billion documents stored in the Wang format, and the company wishes to offer a complete alternative to the IBM DIA/DCA environment.

Data communications now forms more than 40 per cent of Wang's business and the company is rapidly enhancing its efforts in the communications area, notably through advantageous technology-sharing schemes in information-transfer and packet switching. Wang has a programme of data communications and networking developments to strengthen its progression towards integrated information processing. The company's overall strategy is towards user-orientated distributed processing, based on the philosophy that the very structure of business dictates that the majority of work done is at the desktop or within the department or work-group.

Seamless Upgrading

Clearly, as the office automation market has progressed manufacturers such as Wang are only too aware that customers are eager to specify systems with inbuilt upgrade paths which will protect their initial investment in computing technology. Each user wants his upgrade to be simple in terms of both finance and employee training. Wang's concept of seamless growth path, from initial small investments to large-scale systems in a multi-vendor environment, depends on a common 'target horizon', equally relevant to the small business user and to the major corporate or government user. The recent adoption of OSI compliance by large corporations and governments in their tender specifications, confirms that users too now feel that the time has come for such an agreed target for manufacturers to work towards.

Utilising Operations Automation to its maximum potential is more of a human, rather than a technical problem. A key factor for improvement in this direction is improved transparency between functions. Users of some database, spreadsheet, WP and other software packages will not have to learn entirely different keystrokes and instructions to the ones which access their corporate systems as this can often be a major hurdle for new technology.

Wang has also announced a Speech and Telephony Enviroment for programmers (STEP) based on the Wang VS range. Using the most common workstation of all, the telephone, a Wang user can dial into the VS and listen to his OFFICE messages through conversion of text speech. Wang has achieved integration of voice and Telephony into Wang OFFICE, in a manner that will protect the investment that companies have already made in PABXs and workstations. In line with this policy Wang has already formed a number of partnerships and agreements with leading companies in the telecommunications field. These are already providing sophisticated, practical and cost-effective multi-vendor and networking solutions for a wide variety of customers. Wang's strategic relationships in PABXs include a 100 per cent ownership of Intecom and 40 per cent of Telanova, both integrated voice/data PABX companies.

Future Solutions

The next few years will see the increasing predominance of vertical solutions. Today, most companies are less interested in buying non-specialised horizontal systems than they were a few years ago. Increasingly, vertical solutions will be developed by value-added resellers, software houses and systems integrators. Operations Automation, with its concentration on specific applications rather than generic solutions, will answer the need for increased accessability of a variety of databases — on large or small machines — and will enable companies to make use of advanced techniques to access, sort, process and communicate information for the benefit of each and every specific user.

These developments will be led by improved versions of gateway facilitators, such as Wang OFFICE and voice communications. Acting in consort, these will provide the level of presentation services a user will then require; value added networks to provide the level of communications a user needs; and the adherence to worldwide standards he will rightly demand from manufacturers.

By the early 1990s desktop workstations will be highly graphically oriented and capable of displaying detailed image information. As voice applications are gradually integrated into information systems, integrated workstations will begin to replace separate PCs and handsets. □

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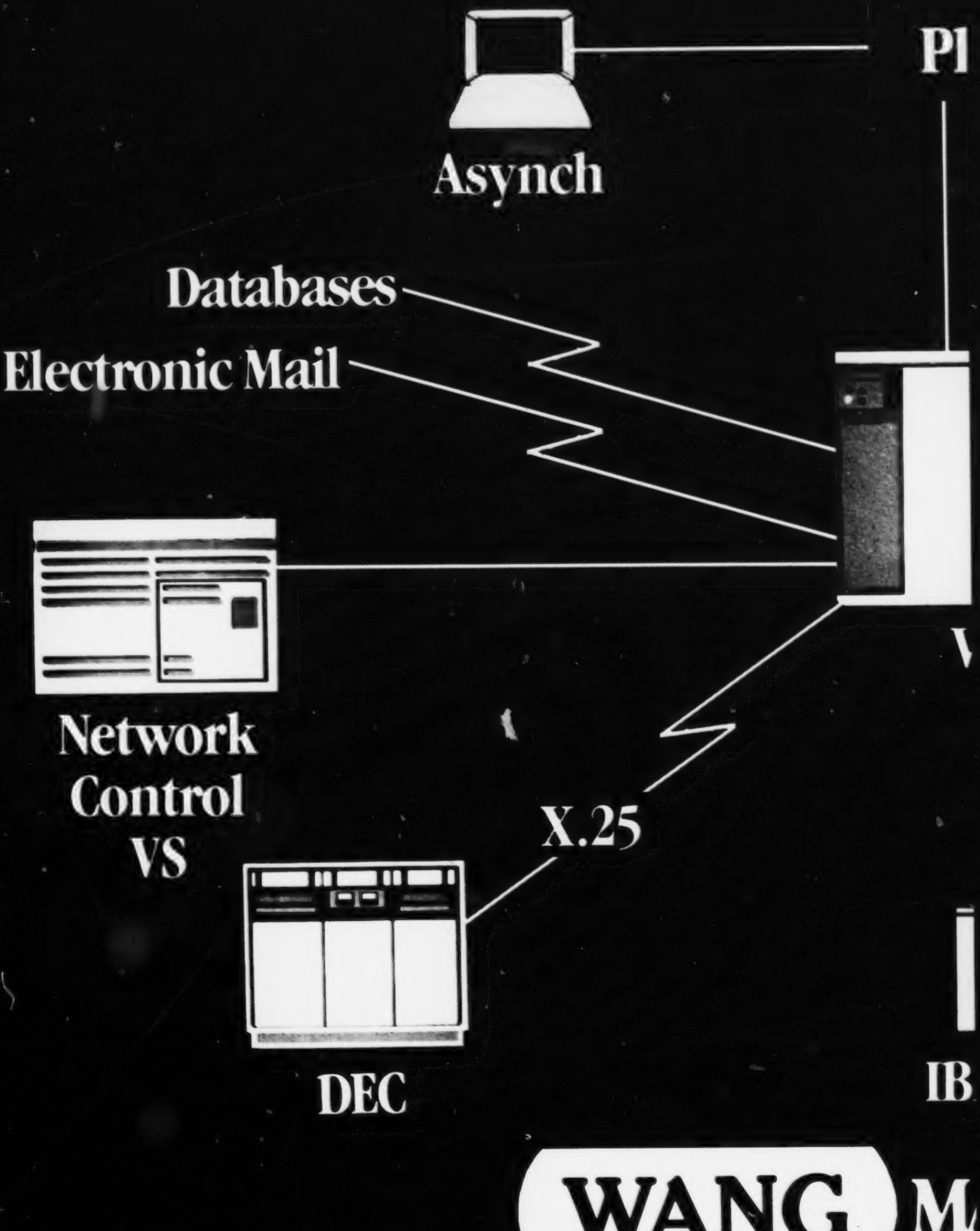
LARGE SCALE MULTI-VEND



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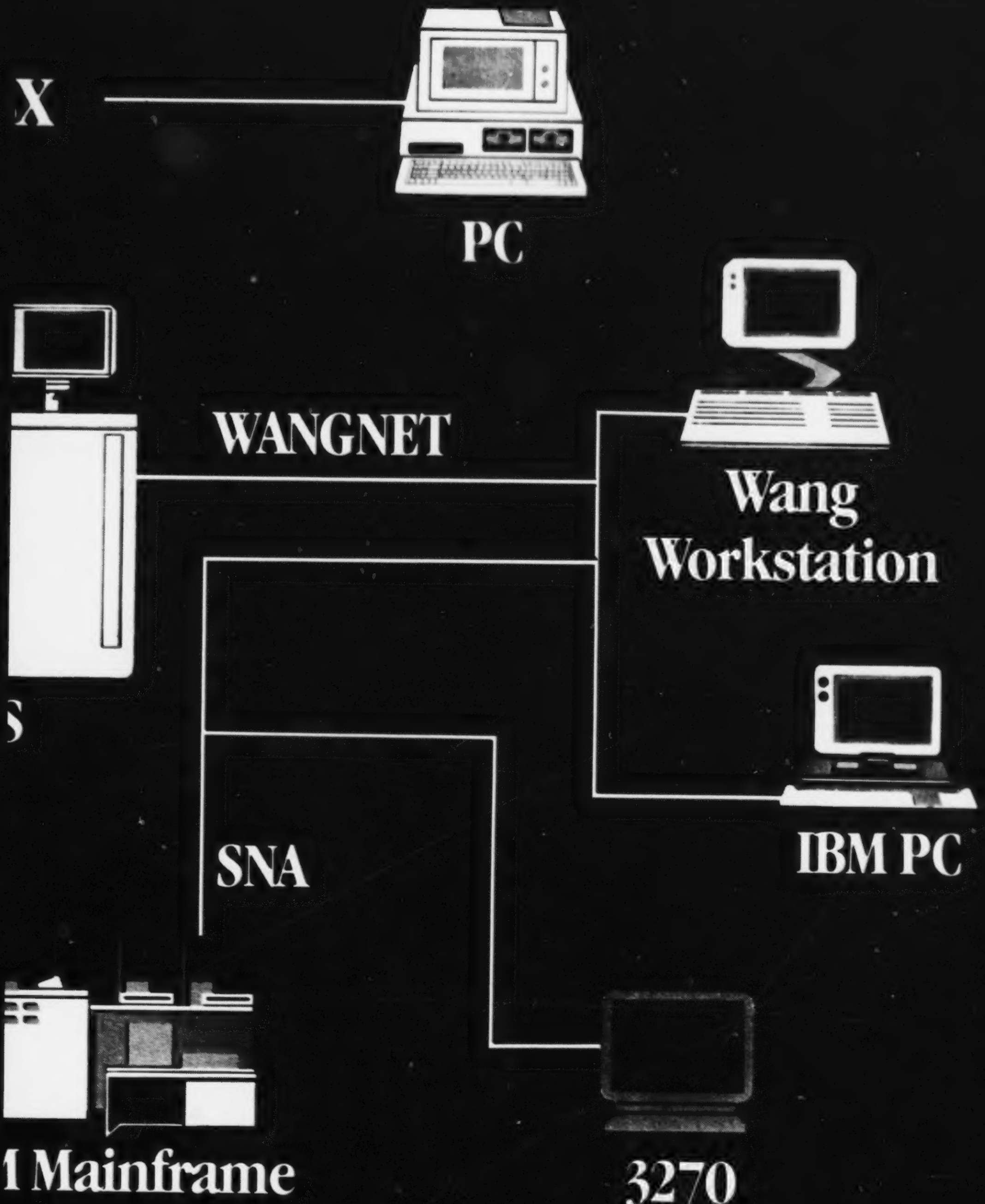
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AKES IT WORK.

Electronorgtechnica

AN optimum combination of seismic and geophysical prospecting techniques is the key to successful prospecting for minerals on a regional scale, including oil and gas exploration and development of oil and gas fields. Over the past few years, prospectors have found numerous and growing applications for computing equipment, which is due to a dramatic increase in the volume of primary information collected in the field and to the use of increasingly sophisticated prospecting methods, such as three-dimensional seismic shooting and high-precision geological and geophysical exploration. These advanced methods have proved to be very effective in locating new oil and gas fields and determining the degree of saturation of the columns of oil and gas basins with hydrocarbons. The amount of data they make it possible to collect is scores and even hundreds of times greater than that acquired through the use of conventional prospecting techniques.

Prospecting information is effectively processed with the aid of the Neftegaz software package which is used by more than 100 geophysical computing centres in the USSR and other socialist countries, as well as in India and the Middle East. Negotiations are in progress on the terms under which the package will be sold to Mexico, Finland, and other countries.

Neftegaz has been developed by the Geophysical Division of the Ministry of Oil Industry of the USSR. It is basically intended for the Unified System range of computers although it can be easily adapted to become compatible with any other type of computer.

Superior Data Handling Capability

In most companies engaged in geophysical prospecting, information collected in different areas with different geological conditions is processed at a single large-scale computing centre equipped with high-performance computers. This is not so in the USSR where prospecting data is processed by a large-scale main computing centre and a network of regional computing centres located in prospective oil and gas areas.

The principal task of the main centre is to develop new algorithms and software. Its specialists work on advanced data processing methods to be used by the regional centres. The results of intensive processing of data obtained in areas with particularly complicated geological conditions serve as a basis for improving the quality of software developed by the main centre

The regional computing centres operate under geophysical reserach and exploration organisations set up in all oil-producing regions of the USSR. The staff of a regional computing centre is normally composed of three groups of specialists.

The first group deals with the processing and interpretation of data. In addition to geophysicists, it necessarily includes geologists intimately acquainted with different geologic features of their region, such as the history of sedimentation, stratigraphy, and oil reservoir properties.

The second group adapts advanced prospecting and exploration methods and programmes to local conditions and ensures proper utilisation of the available software for kinematic and dynamic interpretation of data processing results.

The third group deals with hardware maintenance and the introduction of advanced equipment.

Each regional centre uses two or three standard computers of the ES and SM series.

The efficiency of a regional computing centre depends, above all, on the amount of primary geophysical information and the data processing requirements.

In the case of complicated geological problems, the data processing intensity must be as high as 10,000 to 20,000 operations per word. In the near future, the data processing intensity will be even higher, so the regional computing centres are rapidly building up their computing facilities. Many of them have already acquired general-purpose ES-1061 computers known for their high data file processing efficiency.

Prospecting and exploration have become more effective, because each regional computing centre combines the processing and interpretation of data into a single set of interrelated procedures.

They all use the Neftegaz software package which is generally believed to be superior by far to all other geophysical data processing packages.

The composition of the Neftegaz is as follows.

STsS-3 Standard Data Processing System

This system sorts out data on the basis of station and time intervals and is used for kinematic conversion of seismic recordings with the introduction of static and kinematic corrections. It also serves for amplitude correction and frequency conversion of seismic recordings, including variable and rejection filtering, as well as variable and adaptive deconvolution. Seismograms are analysed for amplitude, frequency, autocorrelation, coherence, signal-to-noise ratio, and resolution. Prior to storing, they are grouped with reference to horizon forms. The system monitors single-channel conversion parameters, revises static and kinematic corrections with reference to stacked seismic sections and common-depth-point seismograms, and suppresses noise on original seismic recordings. It provides for layer-by-layer, step-by-step, Kirchhoff, and Clairbeau migration of time sections. Finally, it processes time sections with zero-phase deconvolution and coherent filtering of random noise.

STsS-3-PGR Geologic Section Forecasting Programs

This system comprises 10 sets of methodological instructions and 92 programs. It is intended for special-purpose processing and analysis of shooting data, geologic section forecasting, seismo-stratigraphic analysis, and the evaluation of lithologic features. The system also detects stratigraphic and lithologic traps, forecasts the presence of reservoirs and oil and gas saturation of rock, and evaluates the magnitude of formation pressures.

The programs are used for special processing of seismic data without distorting the dynamic characteristics of reflected waves, the determination of interval-related and instantaneous dynamic parameters of wave fields, and forecasting physical properties of rock, such as layer and intermediate velocities, acoustic stiffness, and absorption. The STsS-3-PGR also serves to model seismograms, seismic sections, vertical profiles, and sedimentation processes.

SPTsI-1 System of Programs for Digital Interpretation of Data

The system automatically monitors, compares and correlates reflections within a specified time interval and among profiles, produces isoline maps showing faults and featuring three-dimensional surface images, analyses hodographs, performs autocorrelation functions, constructs velocity models of media, and evaluates the accuracy of structural analysis on the basis of information at hand.

STsS-3-3D and STsS-3-PPSN Program Packages for Spatial Data Processing

The STsS-3-3D programs serve to process data resulting from wide-line observations and observations conducted with the use of uniform measurement point grids. The STsS-3-PPSN package serves to process data resulting from observations in arbitrarily selected areas.

Both program packages perform the basic geophysical procedures, such as three-dimensional migration, the construction of horizontal sections of three-dimensional wave fields, and the modelling of such fields on the basis of an analysis of actual sections.

STsS-3-VSP Programs for Processing Vertical Seismic Profiling Data

These programs are used to determine the acoustic properties of rock with reference to well logs, analyse wave fields with reference to three-component recordings, and investigate the geological structure around a well.

ASOIGIS Program Package for Processing Field Geophysical Survey Data

This package is intended for lithologic classification of layers and spatial localisation of reservoirs on the basis of a variety of logging techniques. Data is processed by using both qualitative and quantitative criteria. The results of processing are used to evaluate oil and gas reserves, as well as to determine and control production conditions.

TBD Data Base System

It comprises a data base loading subsystem, an information retrieval subsystem, and a package of processing programs.

The TBD selects relevant data and passes it on to processing programs and the ASOIGIS system. It is used for plotting, the calculation of statistical characteristics, the forecasting of geological parameters through the use of mapping, and other purposes.

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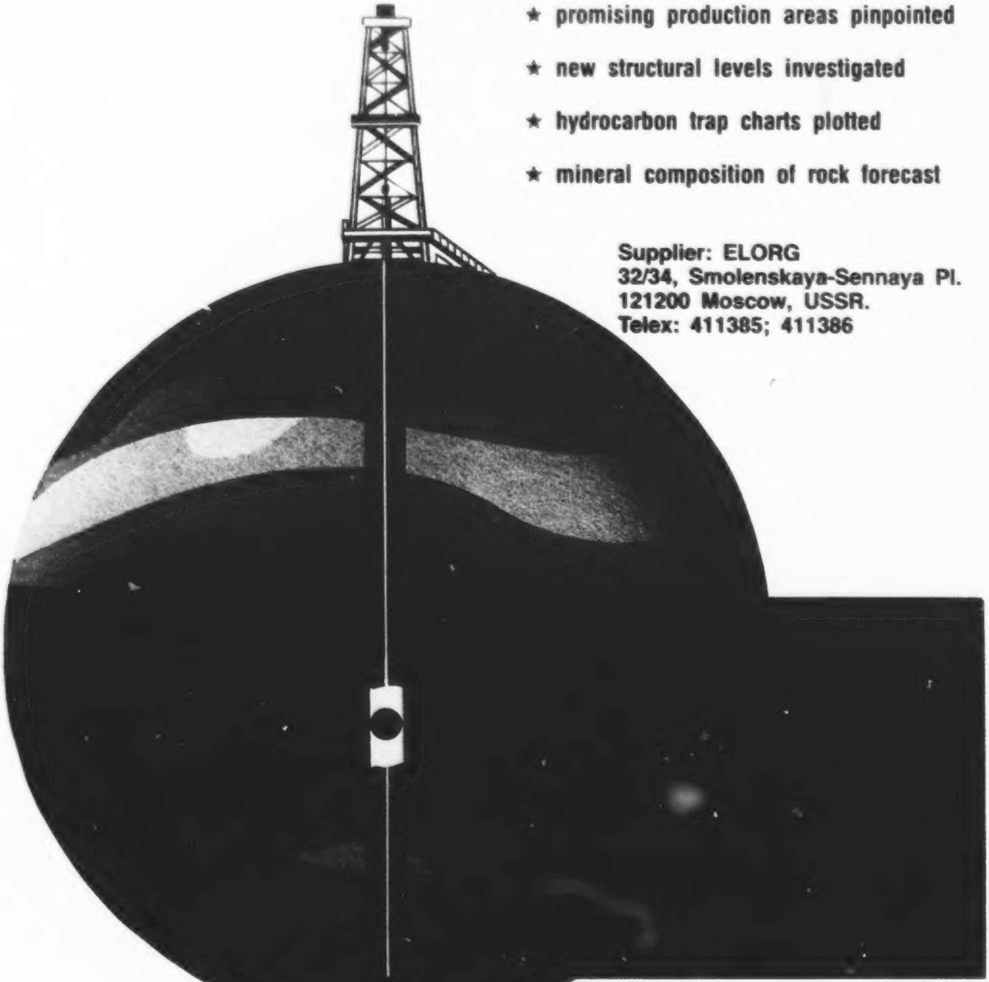

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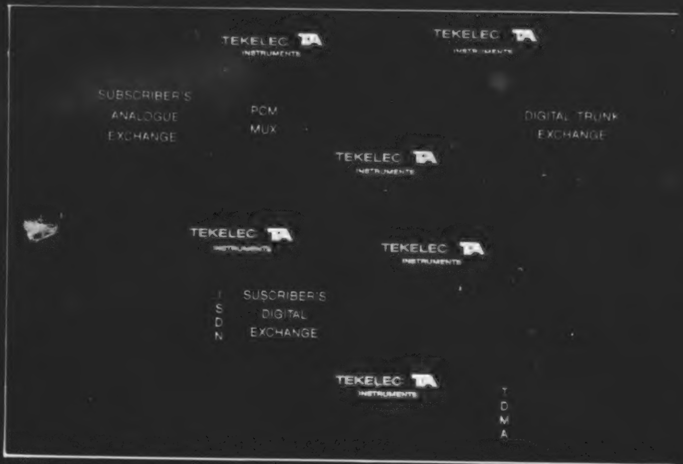
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Everywhere in the world, telecommunication networks are considered as a major priority, and it is very common to design telecommunication networks in areas where traditional energy resources are unavailable. There, photovoltaic techniques bring the solution to this problem, and exactly fit the requirements of telecommunication stations.

Beyond the economical aspects, the photovoltaic conversion allows new possibilities such as:

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- Very low maintenance (allows to extend networks in areas where no specific skills are available);
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Composition of a Photovoltaic Generator

The 'chain' of the equipment is designed to provide the following:

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- the storage of energy: storage battery;
- the management of the stored energy: charge regulator;
- the matching of the electrical characteristics of the stored energy to the requirement of the equipment to be powered: invertor;
- the electrical links between each piece of equipment, i.e.: cables, junction box, etc.

Having over 25 years of experience, and constantly researching and developing new technologies, PHOTOWATT Int'l SA, the European leader in photovoltaics, has today several hundred references within the telecommunication field.

The first really significant installations in this field, began in 1968; A huge programme concerning the installation of transmitters for educational TV took place in Nigeria.

PHOTOWATT equipment is now found being used throughout the world for multiple applications: Repeaters, radio-transmitters, TV transmitters, Data transmitters, radio-telephones (terrestrial and off-shore), telephone booths, VHF/UHF transmitters . . .

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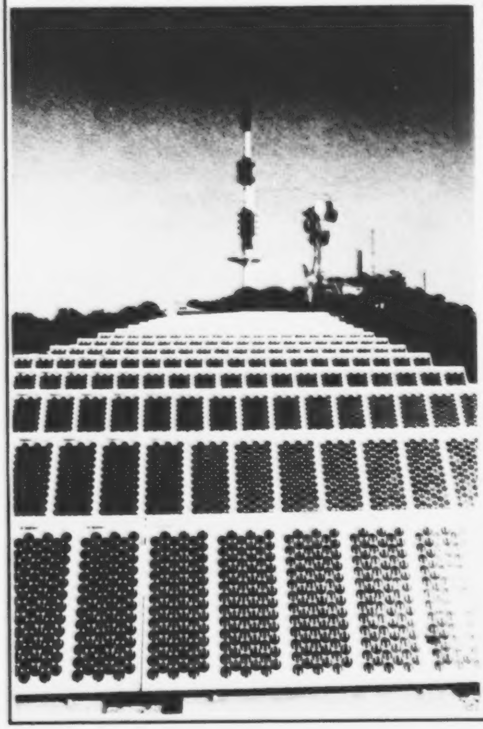


POWER

BATTERIES FOR BACK-UP POWER

by George Wilson

As the technology involved in communications systems grows increasingly sophisticated, the need for an absolutely reliable and clean power supply becomes even more crucial. Consequently, uninterruptible power supply (UPS) equipment has an essential role to play in many networks, especially in developing countries where the electricity supply can be subject to fluctuations or even fail completely. George Wilson, Consulting Engineer to Chloride Industrial Batteries Ltd, describes the requirements for an efficient UPS standby battery.

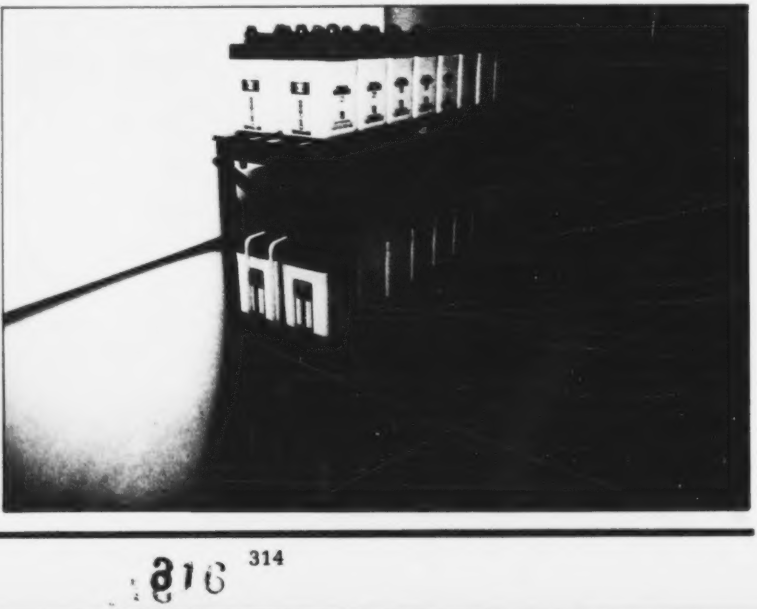
WHILE the quality and reliability of the mains supply in the United Kingdom are excellent by any standards, there are many applications where the provision of an uninterruptible power supply (UPS) is essential. This provision is even more necessary in developing countries where breaks in the public supply may be more frequent. There the mains electricity distribution networks tend not to be so reliable due to difficulties often caused by climate and terrain.

With the ever increasing use of computer-based telecommunications systems, the demands on power supply integrity have been ever more exacting. In these applications it is essential to avoid the slightest break in supply and also to ensure a clean supply to avoid loss of memory or distortion of data.

Voltage fluctuations, for example, can create serious operational problems. When the voltage is too high, equipment may be damaged or destroyed. When the voltage is too low, computerised systems may lose memory and function improperly, thereby corrupting the data throughput. It is therefore essential to interpose UPS equipment between the mains and the computerised equipment, in order to serve two roles.

First, it protects the computer from public supply transients by maintaining stability of voltage and frequency and reducing the harmonic content. Second, it maintains power to the load in the event of a complete failure of the public supply.

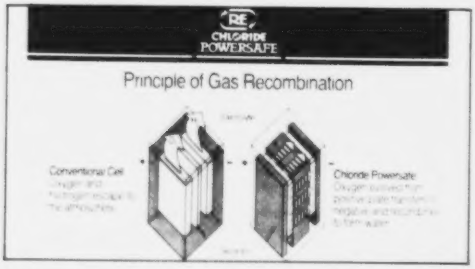
In order to fulfil the second role, a standby battery is required, with sufficient capacity to supply the load until such time as the public supply is restored or until a standby generator can be brought on line. A typical UPS will comprise a solid state inverter, rectifier/charger, static switch and standby battery. Under normal conditions the alternating current (AC) mains power is converted to direct current (DC) by the rectifier in order to keep the battery in a fully charged condition and, at the same time, to supply DC power to



__Right__: A recombination electrolyte battery requires 70 per cent less space and is 50 per cent lighter than a comparable conventional battery.

the static inverter. The battery and inverter filter out AC line transients and provide frequency-regulated AC to the load, even if the original line voltage or frequency should vary. If the public AC supply should be interrupted, the battery continues unassisted to supply power to the load through the inverter, without interruption even for a fraction of a cycle. When the public supply is reinstated, the rectifier automatically resumes operation, supplying the inverter and also recharging the battery. The function of the static switch is to protect against failure or malfunction of the UPS by automatically switching the load to the mains supply until the fault has been cleared.

In many respects the requirements for a modern UPS battery are different and more onerous than for any other battery application. There have been tremendous advances in recent years in electronic technology, resulting in a dramatic reduction in the dimensions of electronic equipment such as telephone switching equipment, computers and inverters. Users demand a corresponding reduction in the size of standby batteries and the elimination of costly, dedicated battery rooms and long cable connections.



Above: *Topping up is eliminated with recombination electrolyte batteries, meaning a reduction in maintenance.*

When UPS equipment was first introduced the most expensive, long-life batteries were employed. But as the equipment has evolved, the battery requirements have changed drastically. Although the greatest possible reliability is still necessary, the demand now is for less expensive batteries, designed for a life expectancy of only 10 years or so, with correspondingly reduced cost. As UPS equipment has reduced dramatically in size, lighter, smaller batteries are needed, but these must still be capable of giving very high rate discharge performance. Coupled with this, the demand now is for 'office-compatible' batteries with minimum maintenance.

The requirements for a modern UPS battery can thus be summarised as:

☐ reliability;
☐ safety;
☐ no topping up;
☐ high power/volume ratio;
☐ high power/weight ratio;
☐ 10-year design life;
☐ office compatibility;
☐ cost-effectiveness.

To meet these requirements, a new generation of batteries has been developed using recombination electrolyte (RE) technology.

In a conventional vented or 'wet' cell, hydrogen and oxygen gases are produced during charging and vented to the atmosphere. This means that water is lost, and needs to be regularly replaced by topping up. The principle of RE technology is that the gas evolved is recombined within the cell so that water losses normally associated with vented cells do not occur.

This is achieved by the use of highly porous microfibreglass separator material, in which the electrolyte is immobilised, while at the same time allowing oxygen gas evolved at the positive electrode to diffuse rapidly to the negative, where it recombines to form water. Topping up is therefore eliminated, with consequent reduction in maintenance.

Since gassing during recharge is kept to an absolute minimum under valve regulation, an RE battery needs no separate battery room and may be installed alongside the UPS equipment.

With RE batteries there is no need for electrolyte reserve space above, and mud space below, the plate groups. This gives further space and weight savings when compared with conventional cells. An RE battery requires 70 per cent less space and is 50 per cent lighter than a comparable Planté battery.

Power requirements for UPS are constantly increasing, even though the high current may only be required for a 5-, 10- or 15-minute period between acceptable voltage limits. RE cells employ a large number of comparatively thin plates in a tight assembly. This gives a low internal resistance with correspondingly high current output per unit of volume, making them very suitable for UPS purposes.

Out of all the benefits of the new cells, however, the factor which has had most influence on their introduction is that of accommodation. RE batteries reduce capital outlay because separate battery rooms and expensive busbar or cable runs are no longer required. With a design life of 10 years when installed and operated under the recommended conditions, their intrinsic advantages make them the most cost-effective UPS batteries available. ☐

TAKING THE RISK OUT OF POWER SUPPLIES

by Lou Welt

However sophisticated the technology, the benefits of a modern communications system can still be eradicated by one major problem – lack of power. This is especially true of countries where power supplies are liable to fluctuate or fail altogether. Lou Welt, Marketing Communications Manager of the International Power Machines Corporation, stresses the importance of power protection equipment for any communications system.

THE electrical power that makes any communications system run is often its biggest enemy, especially in locations where the power supply is unreliable or affected by extreme climatic conditions. Microprocessors, computers and other electronic systems – the basic components of modern communications hardware – rely on smooth, 'clean' power. The various types of power disturbances that exist in today's environment can be quite fatal to successful and uninterrupted system operation.

In a data processing system, power disturbances destroy data and can damage or weaken computer hardware, resulting in down time or intermitten problems. Data can be lost or become garbled – something which may not always be evident to the user. Other problems, depending upon the nature of the disturbance, are software or system erasures, file erasures, unexplained problems, disc errors and head crashes. Probably the worst is down time resulting from power failure.

While some of these problems do not concern a voice communications system, it must be remembered that the same types of electronic components are involved and serious damage can occur. A complete, unscheduled shutdown, without warning, can be quite disastrous to many types of organisation, particularly if the affected equipment serves as the hub of a larger telecommunications network.

Computers suffer from several types of power inconsistencies or disturbances and from power outages or failures. Spikes, or sudden voltage increases, are often the result of circumstances related to the utility power source outside the building, lightning being the most usual cause for the largest of these. Oscillatory voltages (noise), surges, brownouts and spikes can be caused within the building, by the starting and stopping of elevator motors, air conditioning motors and other office equipment.

Most devastating of all is a complete power failure. These are usually only momentary, but when you see the lights blink, it is too late for the computer. It is already down. Restarting it takes time – expensive time that is lost from production. In addition, missed deadlines and lost data have to be contended with. In some financial institutions, data processing and transmission down time can cost as much as $100,000 per minute.

A modern electronic communications private automatic branch exchange (PABX) can be put out of operation, too, by a momentary power interruption. Some have an automatic 'soft' shutdown procedure which is initiated by even a momentary power interruption. This immediately shuts down the main switchboard and any electronic terminals. When power resumes, the system's memory is reloaded from a cassette, an operation that requires 20 minutes to an hour. In the meantime the organisation's telephone service or communications network is out of business. If the main switchboard is out, the rest of the system is usually affected. The cost of this to the user may be minimal or excessive, depending upon to what degree the communications system is critical.

Absolute insurance against these potential problems can be achieved with an ininterruptible power supply (UPS) system. This smoothes out variations in utility power, protects against more localised power disturbances and, most important, supplies battery back-up in case of a complete power failure.

Batteries supplied with a UPS system are usually capable of operating the protected equipment for several minutes to an hour or more, depending on the user's requirements. This is long enough to bridge most power outages and allows sufficient time for a back-up engine generator to get on line. If there is no generator or if it fails to start, the time is sufficient for the system to be shut down in an orderly fashion without loss of data and with minimum inconvenience.

Uninterruptible power supplies (UPS) are usually considered too expensive to use with a PABX system alone, as their low power requirements rarely warrant the purchase of a

UPS. However, for organisations that have some form of data processing, the power requirements are such that an efficient UPS is not only justified, but is usually an absolute necessity.

UPS systems are usually purchased with extra power capacity to allow for expansion and for adding peripherals on to the protected electrical circuits. Adding the PABX or other voice communications system to the UPS will require only a very small percentage of the available power and add virtually no extra cost.

Incidentally, a surge suppressor, often offered or supplied with a PABX system, can protect against some power disturbances, but supplies *no* protection against power outages.

There are two general technologies of UPS systems. The traditional silicon controlled rectifier (SCR) systems offer the lowest cost per thousand volt amps (kVA). Because they are noisy and cumbersome, they are usually located, along with their batteries, in equipment rooms or other remote areas. This is fine for a PABX installation; the UPS and the telecommunications system cabinets can be placed out of the way in an equipment room located in the basement or some other remote area.

For data processing, the more advanced state of the art is a UPS system which is transistorised, employs internal redundancy as does the computer it protects, and is made with the characteristics of a computer peripheral. These systems are quiet (making less noise than an electronic typewriter) and are designed to be placed in the computer room along with their battery support.

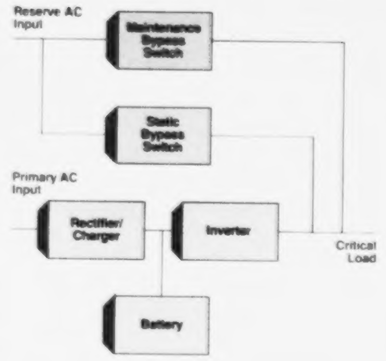
The transistorised UPS system has many advantages for data processing. Its location near the computer eliminates long wiring runs and avoids costly construction. Installation is quick and economical. The cabinets are on castors for easy relocation and require a minimum of electrical wiring. If a fault occurs in a power component, the system automatically detects and isolates the fault and reconfigures itself so that full power continues to the computer without interruption.

A PABX can be powered and protected by either type of UPS. The same protection can be given simultaneously to such auxiliary devices as call station message detail recorders (CSMDR), monitors, printers, voice mail or voice messaging equipment and a voice speaking computer.

As experience has proved, it is quite apparent that the cost of a UPS system can well be less than the potential cost of electrical disturbance damage and/or a sudden blackout. To ease the cash requirement for such a system, it is sometimes possible to arrange a lease for the UPS system from the same company that holds the organisation's computer lease. This is especially true of the transistorised systems which require no permanent installation in the building and, therefore, are not considered capital equipment.

When evaluating the effect power problems can have on communications and data processing, it is clear to see how a UPS can be cost justified, especially if it will fill the needs of two critical departments. ☐

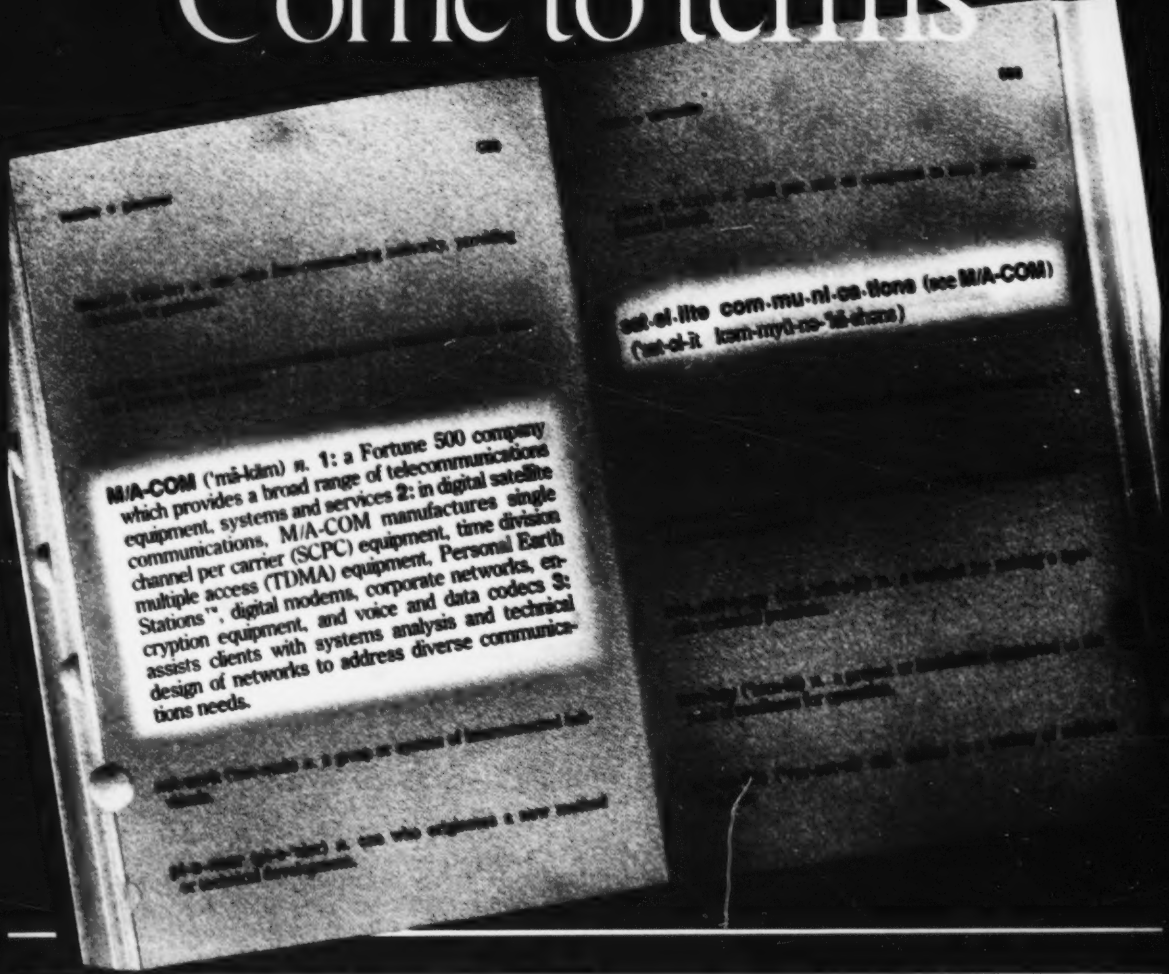
HOW A UPS WORKS



A UPS system receives alternating current (AC) power from a utility's supply lines. This is fed into the UPS system's rectifier which changes it into direct current (DC). From the rectifier, some of the DC power goes to the batteries to keep them charged, but most of it goes to the inverter which changes the DC back to AC and supplies it to the critical load (computer, PABX, peripherals, etc.). The output of the inverter is clean computer power, free of spikes, surges, noise or other potentially damaging disturbances. UPS systems can be made to operate on 50 Hz or 60 Hz AC, whichever is specified. When needed, the inverter can also act as a frequency converter to supply 400 Hz for those systems that require it.

In case of electrical overload or component failure, and during maintenance, a static bypass switch in the UPS transfers the protected equipment from the inverter to a reserve power source without interruption.

Come to terms



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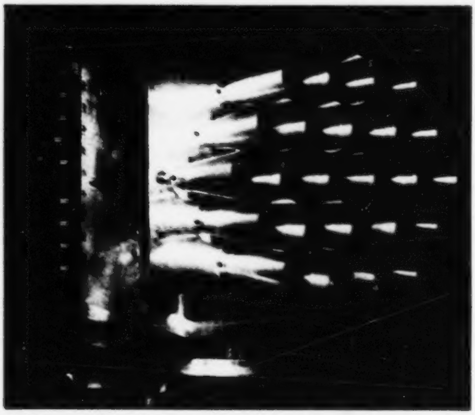
SATELLITES

CHEAPER AND BETTER: THE FUTURE FOR SATELLITE COMMUNICATIONS

by Alistair D Scott

The impact of satellite communications has been enormous and often more significant in developing countries than in the industrialised north. But there is clearly much still to achieve: in reducing costs, launch failure and unreliable performance. Alistair D Scott, Assistant Sales Manager of British Aerospace PLC, suggests some possible remedies for the future.

AS FAR as satellites and satellite communications are concerned, the whole world is still developing to some extent. Huge advances are still being made in even the most sophisticated of the industrialised nations and often the advantages provided by new technology are greater to more recently developed areas of the world. Countries such as Indonesia are actually way ahead of many in the industrial world in that they have owned and operated their own communications satellites for over ten years.



Above: *Phased array antenna, here shown as a development model, could be ideal for rapid scanning or reconfiguring.*

Communications by satellite now cover a multitude of services, such as direct broadcast television (DBS), television and radio rebroadcast and telecommunications. The latter includes telephone, telex, facsimile, data transmission and video conferencing to fixed earth stations, large and small, and to mobile terminals on land, sea and, more recently, in the air. Clearly the advent of satellite communications has made a vast impact on the communications industry as a whole.

Though nearly every household in Great Britain has a telephone, or access to one, and most have a television, they are all concentrated in a very small area when compared to many other countries. The USSR, United States, Canada, Australia and Europe as a whole are all over 3,000 miles from west to east with a large proportion of the population concentrated in urban areas and vast regions virtually devoid of human habitation. Indonesia, the fifth most populous country in the world, stretching 3,500 miles along the Equator, is of a similar dimension to Europe, from the west of Ireland to the eastern edge of Turkey. With over 13,000 islands, but only 6,000 of them inhabited, it has to communicate over vast expanses of open sea.

The government of Indonesia realised that, to unite the country under one flag, it needed efficient communications: instant contact to the furthest corners of its archipelago. Wire provided the immediate solution, but was only practical in areas with higher densities of population such as Java. Microwave line of sight links broadened their sphere of influence, but only down the spine or backbone of the country, along the island chain. Then came the launch of Palapa A1 in July 1976. Since then, both telecommunications and television have been available practically anywhere, just as long as there is a receiver dish and, of course, electrical power.

Many developing countries were first introduced to satellite communications through the international satellite system and then the domestic satellite lease service set up by Intelsat, the International Telecommunications Satellite Organisation. In fact, it is believed that there are currently more earth stations in the Intelsat system carrying domestic services than those carrying international services. Intelsat, formed in 1964 when 11 countries agreed to establish a global commercial communications system using satellites, now has some 112 members and carries about two-thirds of all international telecommunications traffic and nearly all worldwide live television coverage. The remainder is transmitted by terrestrial means such as microwave links and surface and submarine cables.

Despite this, Intelsat does not hold a monopoly. Indeed it faces increasing competition from a number of regional satellite systems which cross national boundaries: e.g. Eutelsat, Telesat, Palapa and, of course, Inmarsat, the International Maritime Satellite Organisation. On the whole these organisations work closely with Intelsat and often lease its spare capacity, e.g. Inmarsat uses the L- and C-band maritime package on the Intelsat V satellites.

The 'takeover' of telecommunications traffic by satellite systems in just over 20 years is a measure of their popularity and success, their flexibility and their instant availability. Of course, cable systems, in particular fibre optics, are fighting back, but they will never provide the flexibility and range of services of a satellite system. They can never satisfy the mobile requirement that is currently provided by Inmarsat, for instance. Cable can complement a satellite, but cannot replace its ability to access the most remote and inaccessible areas, or compete with its extraordinary point-to-multipoint capability and its cost-effectiveness.

In the 1950s, John Pierce of the Bell Telephone Laboratory, impressed by the fact that the new 36-channel submarine cable linking Europe and North America had cost $35 million, asked, 'Would a link 30 times the size, i.e. carrying over 1,000 conversations, or one television signal be worth 30 × $35 million, that is $1 billion? Twenty years later, Intelsat IV carried 6,000 channels and cost just $46 million.

Cable systems require considerable capital investment, take time to install and need constant maintenance. With a 25-year life expectancy, the capacity likely to be required at the end of a cable's life must be accurately calculated before the system is laid. This leads to tremendous over capacity initially, followed by overloading in later years. Terrestrial systems are inflexible. They can be difficult to reallocate, involve long routes, and be expensive and politically inconvenient due to the routing they might have to take.

Better and cheaper communications are the dream of every PTT or telecommunications operator and the aim of every manufacturer. The problem is how to achieve them. For terrestrial communications, the answer must be fibre optics, with the ability to carry increased quantities of information at extremely high speeds. For satellite communications the most obvious solution is the introduction of smaller, more efficient earth terminals.

The use of Ku-band in, for example, Europe and, more recently, Australia, has already led to smaller antennae than the more commonplace C-band systems, owing to the higher frequency. But Ku-band has one major disadvantage – its susceptibility to considerable interference from heavy precipitation. This can be a major problem in many parts of the developing world as tropical storms have been known to cause serious, but often only localised, fading of the signal. Careful system design can overcome this, however, especially as not all services require 99.9 per cent availability.

Improvements have been made in the ground segment and a number of new ideas are currently being developed and tested. Some suggested modifications involve the overall systems architecture such as the use of networks, rather like a spoked wheel with a central hub. As the Inmarsat system has demonstrated, there is considerable demand for this type of system in a mobile role. It is also an attractive option in certain parts of the world where over 90 per cent of the traffic flows to and from the hub (e.g. a capital city or business headquarters), and only a small proportion between the spokes or around the rim of the wheel. The advantage here is that only the hub needs a large expensive transmit/receive dish; the rim stations can be a fraction of the size and power and, of course, cost.

Small terminals, VSATs, are now available, especially in the Ku-band, and the costs are coming down to below $4,000 for dish sizes of between 1.2 and 1.8 metres. The larger C-band 3- to 4-metre dish stations can be as much as seven to 10 times as expensive.

The ground terminals themselves are constantly being improved. The introduction of mass production techniques, new materials and new components, such as solid state transmit amplifiers, have reduced the cost and increased performance and reliability. Many more antennae are now offset fed with new feed designs giving greater efficiency, polarisation purity and a dual polarisation capability. The gallium arsenide field effect transistor (FET) low noise amplifier has provided manufacturers with a small, lightweight and weather-resistant unit which can easily be mounted on the feed arm. The performance of these units is good, giving extremely low noise, and they are now quite cheap.

Improving the size and performance of the ground terminals may reduce the cost to the user or receiver, but maintaining or improving the quality of the service itself normally requires increased performance in the space segment. When compared to the savings which could be made by using much smaller terminals, the expense of improving the performance of the satellite becomes almost insignificant.

There are many ways of increasing the EIRP (equivalent isotropic radiated power) of the satellite to give better reception on the ground. First, the efficiency of transmit amplifiers could be improved or the power of some or all of the amplifiers increased. But more power means either more solar cells on a larger satellite or fewer transponders on the same size spacecraft. Higher efficiency or high power amplifiers may be of greater size and mass and would probably operate at higher temperatures requiring improved heat dissipation. However, solid state power amplifiers are constantly being improved in performance, efficiency and reliability and should also be reducing considerably in size and, ideally, cost.

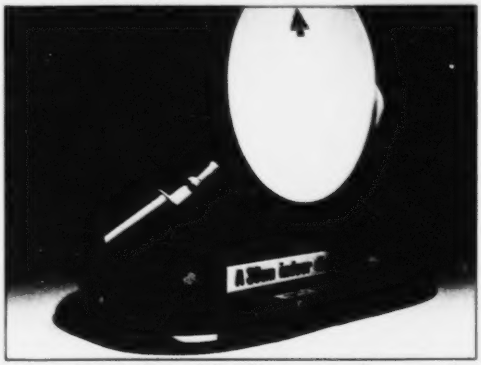
Secondly, the gain of the satellite antennae could be increased. This can be achieved simply by using larger reflectors, but computer-aided design and manufacture has led to new highly-efficient designs. New materials and manufacturing methods have opened the door to more complex grid patterns, multiple feeds and branching networks. Now the introduction of the phased array antenna may lead to even more exciting developments as its electronic beam movement makes it ideal for rapid scanning or reconfiguring.

Thirdly, spot or pencil beams can be used. These considerably increase the EIRP on the ground, but limit the coverage area. They do, however, allow frequency re-use by the careful alignment of a number of beams and, with accurate steering or repointing, the whole satellite can be reconfigured for a new orbit location or for reallocation to a new customer. Spot beams can also be shaped to match accurately the often complex outline of the territory to be illuminated, thus reducing the troublesome overspill into neighbouring countries while further increasing the gain. Methods include multiple feed antennae using complicated beam-forming networks, and now the somewhat simpler single feed on to a computer-designed, shaped reflector. This allows high power to be directed towards the higher density population areas where smaller antennae would be more popular and the commercial service more profitable.

At present, satellite communications are cheaper, call for call, than certain terrestrial systems, but can this continue with the huge costs involved in the design and manufacture of spacecraft hardware, software, and the expense of the launch itself? The risk of launch failure may appear to have increased considerably over the past couple of years, but the situation can only improve. Reducing the risk should help to reduce the cost.

More efficient launch methods and more reliable satellite components are the key. Safer launches would reduce the launch insurance and give a better guarantee of a launch date, while a reliable satellite would both reduce the operational insurance cost and reduce the actual cost of operation by extending the life.

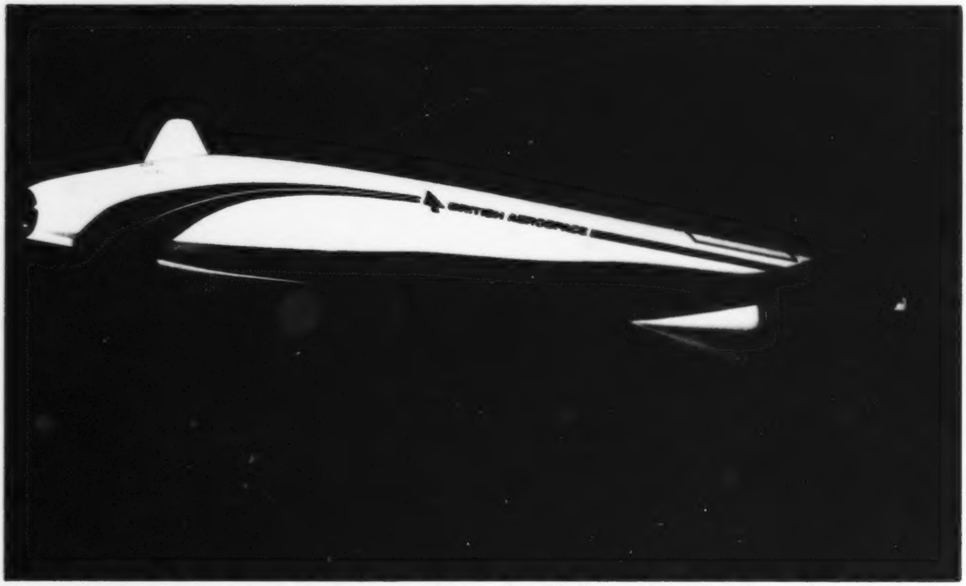
The unreliability of the travelling wave tube amplifier is one of the most common causes of failure of individual transponders, especially at the higher powers. Replacing them with solid state power amplifiers (SSPAs) would be a first step towards higher reliability.



***Above:** Technological developments will soon make it possible to receive direct broadcast television by satellite using a dish as small as 30 centimetres in diameter.*

Many other improvements at component and sub-system level are either being investigated or are already being incorporated into the satellites of the early 1990s. Manufacturers have benefited from analysing the millions of hours of in-service operation of components. Add to this the highly sophisticated life-testing that is now carried out and we have a far better understanding of the long duration operation of satellites. Considerable effort is applied to the design of ever more failure-resistant circuits and more is now known about radiation dose effects on components. Solar cells are still improving, increasing in power and extending life expectancy.

Even so, the life of a satellite is still governed by the fuel it carries for positioning. This can be extended by conserving fuel, and techniques such as solar sailing, using the pressure of the solar wind on athe solar arrays, and the use of bi-propellant fuel systems for both the



***Above:** HOTOL, the unmanned single-aircraft-to-orbit project being developed by British Aerospace, should provide cheaper and more reliable satellite launching.*

positioning thrusters and the apogee boost motor are already in service. But the biggest saving must be in the guaranteed accuracy of the launch which then reduces the fuel required for accurately placing the satellite on station.

There must be a better and more cost-effective way to launch satellites into space than to sit them on top of enormous, highly explosive rockets which cost tens of millions of dollars, most of which is discarded, falling into the ocean or left to drift off in space. There is mounting concern about the accumulation of man-made debris in orbit and NASA already watches over 6,000 trackable objects to make sure a shuttle does not collide with this space junk. However, a number of studies are under way at the moment which could revolutionise the launch scene.

Arianespace is continuing to invest in its Ariane expendable rocket by developing the massive Ariane V. Germany is looking at the Sanger project, a two aircraft system, one for horizontal take-off to high altitude, and the other from there out to low earth orbit.

Meanwhile, the United Kingdom is studying the potential for British Aerospace's HOTOL, an unmanned single-aircraft-to-orbit solution. HOTOL should satisfy the two prime requirements, cost and reliability. It is expected to cut the cost of launching each satellite to low earth orbit to a fifth of that of the shuttle and it should have the reliability of a supersonic aircraft. Horizontal take-off from a large runway, on Concorde-style wings using air-breathing jet engines, should satisfy the most nervous of launch customers. The 8-tonne payload of one or more satellites would hardly notice the 0.6g acceleration and the 280 knot take-off speed. On lift off, the 'take-off' trolley is left behind and the aircraft goes supersonic within one and a half minutes, reaches Mach 5 and 26km altitude in eight minutes, and achieves orbit velocity at 90km altitude.

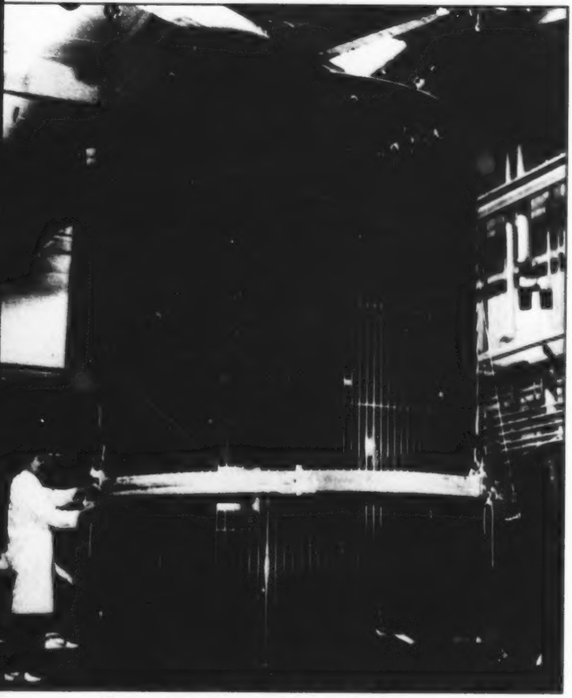
The secret of success is, of course, the engine which is being developed by Rolls Royce. At about 26km altitude, the engines swap from air to oxygen breathing and the aircraft is then boosted up to 90km, where they are shut off. The vehicle then coasts out to a 300km orbit. With a typical mission time of two days, HOTOL will be able to launch, service or recover satellites in low earth orbit and, after a high incidence re-entry, return to earth at the most operationally suitable airport. It will land on its own undercarriage and, with a rapid turnaround time, should be ready for another mission in only two or three days – truly a transport of the future which will ease the constraints on satellite design and manufacture currently imposed by today's launchers.

Satellite communications have limitless potential. To make the future happen we must study all those areas which could be improved – life expectancy and reliability, operating costs and initial purchase costs, quality and performance. And we must evaluate every solution carefully. □

SATELLITE SERVICES LEAD THE WAY

by Joseph N Pelton

Global satellite communications have enormous potential for developing countries, bringing people into contact with new markets and new ideas. Yet often the investment required is too high when resources are limited. Joseph N Pelton, Director of Policy for Intelsat, the global telecommunications satellite network, describes the range of programmes initiated and run by Intelsat which are designed to overcome these problems for developing countries.



Above:* *The first of the Intelsat VI series, due to be launched in autumn 1988. The world's most powerful commercial communications satellite, it will be able to carry simultaneously 120,000 telephone calls and at least three television channels, or 3 billion bits of information per second. Photo courtesy of Hughes Aircraft Company.

AMONG international organisations, Intelsat, the global telecommunications satellite network, is unique. Formed in 1964 to provide satellite communications on a non-discriminatory basis throughout the world, the organisation has grown to encompass 112 member nations, with its satellites used by more than 170 countries and territories around the world. Today, the Intelsat system carries two-thirds of the world's international telephone and data traffic and virtually all transoceanic television. The remaining traffic is largely carried on submarine cables. Over two-thirds of Intelsat's members are developing countries and 20 of the 27 countries who use Intelsat satellites for domestic service are developing countries. In many different ways Intelsat has been especially responsive to the needs of these countries, and has implemented many programmes in communications development that are closing the gaps between developing and developed countries.

In the light of the changing international telecommunications environment, where there is increasing emphasis on deregulation and pro-competitive practices, there are fundamental issues being raised as to whether developmental programmes by Intelsat and others will be adversely affected in the late 1980s. These are no small issues, since communications development is critical to the overall economic and social development of the Third World.

In an effort to improve telecommunications in developing countries, Intelsat runs several different programmes and projects.

The Intelsat Assistance and Development Programme (IADP)

The IADP was initiated in 1978 and was designed to provide free technical and operational assistance. In some cases, where extensive assistance is required, the assistance is provided on a cost-reimbursement basis. By the end of 1986, over 90 countries had benefited from IADP assistance, some more than once on different issues. The IADP also sponsors seminars related to earth station technology and new Intelsat services.

The scope of the assistance provided through IADP is wide and varied, encompassing various broad categories:

☐ planning and development of international satellite services, including feasibility studies, preparation of performance specifications and requests for proposal, evaluation of technical proposals, monitoring and implementation, verification and acceptance testing, upgrading and retrofitting.

☐ initial planning and expansion planning for domestic lease services, including feasibility studies, transmission and network planning, earth station design and proposal evaluation.

☐ training assistance, including seminars related to the planning, procurement, implementation, operation and maintenance of earth segment facilities intended to work with the Intelsat space segment.

In all IADP activities, special emphasis is placed on assisting recipients in carrying out the work themselves. In this way, the programme aims towards long-term assistance. There is already evidence that this approach is bearing fruit, as requests for assistance are increasingly more concerned with planning and development rather than 'rescue and maintenance'.

The location where the assistance is provided and the length of time spent on each project varies considerably. Some IADP assistance is performed at Intelsat headquarters in Washington DC, other kinds are provided on location. Some tasks may be completed rapidly, while others may take many months (such as earth station planning, procurement and installation).

New services for thin-route satellite communications

Vista

Spurred on by the efforts of World Communications Year, the Maitland Commission of the ITU, and aware of previous success stories of experiments conducted in the Pacific Basin, Africa, India and elsewhere, Intelsat initiated its own efforts to assist world development, leading to the introduction of Vista service in December 1983.

Vista services are designed to provide the basic communications facilities of voice, telex, teletype and low-speed data for rural and remote communities presently having inadequate or no telecommunications services. The primary purpose of the Vista service is to serve the vast majority of the world's population who live in rural or remote areas and who are hampered in their economic and social development by inadequate long-distance communications facilities.

Typically, Vista's users are communities with relatively small long-distance communications requirements – sometimes only one telephone circuit. Such communications not only provide economic benefits, but critically important access to the outside world in the case of medical emergencies and natural disasters. Even limited communications capabilities, when reliable and affordable, can contribute significantly.

Vista's effectiveness relies on the availability of relatively small, low-cost earth stations of simple design and low power consumption. Intelsat relaxed and modified several of its mandatory performance characteristics to accommodate these design characteristics into a special earth station standard for Vista called 'Standard D'. Even with these relaxed standards, however, the original Vista service did not realise its fullest potential due to the relatively high cost of the earth stations for prospective users.

It is for these reasons that two further innovations were undertaken to lower the cost of thin-route satellite service even further. These new developments were Super Vista and the Vista Bulk Purchase Programme.

Super Vista

Super Vista was established as a new type of Vista service with an even lower cost space segment charge. The key to Super Vista is the use of demand assigned multiple access (DAMA) techniques, which allows more channels to be fitted into the same satellite transponder. Several studies of light-route traffic indicated that demand assignment could significantly reduce the number of satellite trunks required to serve the same traffic. The advantage obtained, namely the ratio of user access to satellite channels is, however, dependent on the number of user accesses involved. Since it is difficult to charge the users for precisely the amount of space segment utilised without implementing a very complex monitoring system, a practical way of going about this was to charge for the number of channel units used in the system. This will, in turn, depend on the type of network operating in the configuration.

The Vista Bulk Purchase Programme

Although the earth station standards for Vista earth stations had been relaxed, the earth stations were still relatively expensive for prospective users. Thus, about the same time that the Super Vista service was introduced, Intelsat also initiated a new Vista D-1 Earth Station Procurement Programme. Intelsat, acting as a purchasing agent on behalf of Intelsat signatories and non-signatory users, undertook a bulk purchase procurement programme to obtain significant discounts in the price of Vista earth stations. After a rigorous international procurement process, Intelsat selected a preferred contractor, based on a combination of quality, price and delivery time. While a single channel earth station bought individually might cost in the range of $80,000 to $100,000, through the volume purchase programme, a single channel Vista earth station is now available for about $50,000 (FOB).

It is important to note that the involvement of Intelsat in the Vista D-1 earth station procurement programme is, in principle, intended to end with the signing of the volume discount agreement (VDA) with the contractor. From then on, interested purchasers should carry on their procurement process directly with the manufacturer. The VDA is designed to serve as an umbrella agreement under which the type of equipment and support services to be purchased, and the corresponding prices, as well as the basic terms and conditions are specified. Thus, each purchaser is expected to place a purchase order with the contractor for one (or more) earth stations and the associated standard options within the terms and conditions contained in the VDA. The requirements peculiar to each purchaser that may need to be negotiated directly between the purchaser and the contractor might include: transportation to site, turnkey procurement, repair and maintenance agreement, signalling interface, extended training and other non-standard options.

Intelnet

Intelnet is one of several new Intelsat services that are keeping pace with the digital information age. It can operate on national, regional or international levels to provide data among and between small (as small as 2 ft or 65 cms in diameter), inexpensive microterminals and a central hub earth station(s). It is designed to become an indispensable tool for industries and government organisations, as well as private and aid-oriented agencies, dependent on their ability to distribute information to, and gather information from, remote places. Intelnet can be equally effective in serving the needs of developed or developing countries.

The small terminals are, in fact, particularly well suited for applications in rural and remote areas because they are small, lightweight, easily transportable and can operate without large amounts of electrical power. They can be deployed at widely distributed locations, either domestically or internationally, for the reception of one-way broadcasts of news, commodity prices, weather information, agricultural extension service, remote newspaper printing, or any other printed material that is compatible with the presently approved rate of 9.6 kilobits/second. Intelsat can be provided on either the C-band or the Ku-band, as either a full time lease, or for 'occasional use' services.

Intelsat Business Services (IBS)

This is a totally digital integrated service, with no distinction made between specific service applications. It is available on a leased transponder basis or on a bit rate basis. This service is primarily designed for the purpose of networking and, as such, is normally thought to respond to the telecommunications needs of large businesses. In Asia, the Middle East, South America, and even Africa, interest in C-Band IBS is becoming clear. The ability to use small terminals of 3.5 to 8 metres to provide both private service and even public television services is proving a popular option.

Intermediate Data Rates (IDRs)

The Intermediate Data Rate (IDR) service is specifically designed to accommodate customers making the transition from frequency division multiple access (FDMA) or frequency modulation (FM) telephone traffic, to digital modes. The IDR digital carriers in the Intelsat system utilise coherent modulation, operating at information rates ranging from 64 kilobits/second (kb/s) to 44.736 megabits/second (mb/s). It is a highly appropriate and effective technology for countries with small to medium requirements, since the annual cost of operating a 3 mb/s data stream is as low as $15,000. Using such an IDR digital transmission rate with compression and speech interpolation techniques, up to 480 voice channels can be derived from such a modest investment. Over the next decade IDRs could well become the most rapidly growing new service in the Intelsat system.

Intelsat lease services

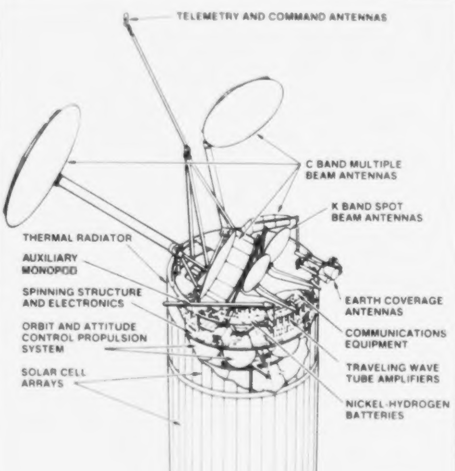
Intelsat began offering leased transponder capacity for domestic services in 1974. In 1982, capacity was also leased to support full-time international television channels, and in December 1985 the Intelsat Board of Governors established two new categories of planned domestic service. By early in 1986, Intelsat had decided to offer the sale of transponders as an alternative to leasing capacity.

As of June 1986, 27 countries were leasing the equivalent of close to 36-MHz transponders in the C-band and in the Ku-band for domestic purposes. These leases may be categorised into four major areas: trunk telephone among major population centres; thin-route telephone for remote areas; television distribution intended for rebroadcast; and television distribution intended for community reception.

Leases have been successful because they meet precisely the needs of developing countries. They can supply as much capacity as is needed to meet communications requirements, economic development and implementation of the national infrastructure (roads, telecommunications systems, etc.) They allow countries to gain experience in the planning, operation, and maintenance of satellite systems without committing the huge resources necessary to set up their own systems.

In recent years Intelsat has seen that almost 10 per cent of its total revenue comes from lease services. Countries have realised, in increasing numbers, the advantages of leasing transponder capacity for domestic or international television services, thus benefiting from the long experience of Intelsat in satellite development, launch facilities and satellite operations, as well as the resulting economies of scale. Their confidence has been fully justified as Intelsat maintains a remarkable satellite reliability record (99.98 per cent).

In December 1985 the Intelsat Board of Governors approved a further provision for planned domestic services, consisting of the sale and long-term lease of spare space segment capacity. These two new categories of service, available to signatories and non-member user administrations, are: the sale of Intelsat transponders for domestic use, and non-preemptible, fully protected long-term leases, either cancellable or non-cancellable, for domestic services. These planned domestic services meet an important, immediate service requirement of many signatories, with lower overall prices for all classes of service.


TELEMETRY AND COMMAND ANTENNAS
C BAND MULTIPLE BEAM ANTENNAS
K BAND SPOT BEAM ANTENNAS
THERMAL RADIATOR
AUXILIARY MONOPOD
SPINNING STRUCTURE AND ELECTRONICS
ORBIT AND ATTITUDE CONTROL PROPULSION SYSTEM
SOLAR CELL ARRAYS
EARTH COVERAGE ANTENNAS
COMMUNICATIONS EQUIPMENT
TRAVELING WAVE TUBE AMPLIFIERS
NICKEL-HYDROGEN BATTERIES

INTELSAT VI

Project SHARE

On 13 August 1984, Intelsat and the International Institute for Communications (IIC) announced Project SHARE (Satellites for Health and Rural Education). This was originally planned for a 16-month period (from 1 January 1985, until 30 April 1986), during which time Intelsat would donate free use of its satellites for tests and demonstrations in the fields of health care and distance education. The project has proved itself to be so successful that it has been extended twice, and will now be operational until the end of this year.

Project SHARE was launched as part of Intelsat's 20th anniversary celebration. The project emphasises geographic diversity and the practical implementation of technology, and is capable of encompassing projects of practically any duration and scope. Additionally, Project SHARE has provided closer communication with many other individuals and developmentally-oriented organisations.

All projects must be approved for their technical feasibility by the signatory (the national designated entity which owns and operates the earth stations accessing Intelsat satellites and which represents a member country in Intelsat). The project must also be authorised by an international panel of experts, the International Advisory Council (IAC), who evaluate each project for its originality, economic feasibility, technical and operational objectives and the credibility of the sponsoring organisation.

One example of a highly successful project was an educational project sponsored by the Ministry of Posts and Telecommunications and the Ministry of Education of the People's Republic of China. This project set a goal for education, at a university level, of students at some 53 different locations throughout China. The programme was later expanded to include educational material from outside sources, and evaluation and studies of the project will be conducted in order to give others an idea of how such projects can be implemented.

This particular project was so successful that, rather than stop their work at the end of the Project SHARE free timeframe, the People's Republic decided to buy the transponder they had been using for the programming. At the same time, they also decided to buy another, extra transponder, for additional educational programmes.

Another example of a successful Project SHARE project is being conducted by Dr Max House of the Memorial University of Newfoundland. This project links the Memorial University Telemedicine Center with university medical centres of Nairobi in Kenya and Kampala in Uganda. The service uses voice telephone lines to conduct audioconferences between the doctors, and also to send EEGs (electroencephalograms) and EKGs (electrocardiograms) from Africa to be diagnosed by specialists and sophisticated computers at the Canadian medical centre. This is perhaps one of the best uses of what is sometimes called 'appropriate technology' because in using simple telephone links the equipment is easily repaired if broken, does not require lengthy training to use, and is relatively inexpensive.

These are only two examples of the many different types of projects that SHARE is currently carrying out. The programme, as defined, was deliberately left open in many ways in order to allow as many different types of technologies and ideas as possible to be included. When the operational period is over, evaluations and reports will be conducted and published and these will be made available to individuals and organisations throughout the world who are interested in similar applications of satellite technology.

Intelsat Development Fund (IDF)

It became apparent when many of Intelsat's new services were introduced that the countries that could most benefit from them were unable to do so simply because the funds were not available. Therefore, in an effort to make these services more available and because it is important to Intelsat, in terms of meeting the letter and spirit of the Intelsat Agreements (which stipulate that the organisation provide expanded telecommunications services to all areas of the world, on a global and non-discriminatory basis) in March 1985, Intelsat's Board of Governors approved the establishment of the Intelsat Development Fund (IDF).

This is not a standing or a revolving fund, but rather a mechanism for providing professional assistance in either setting up an externally financed communications development fund or of locating sources of capital financing. The specific types of assistance envisaged might include help in identifying financing sources, assistance in the preparation of supporting documents for loan or grant applications and, if necessary, assistance in loan negotiations.

The range of financing options explored is tailored to the needs and special characteristics of the country seeking assistance and of their specific project. Because IDF manages each project on a case-by-case basis, the range of options is quite variable and the method employed simply best for solving the particular problem being addressed. In some instances, Intelsat is also looking at such innovative financing plans as countertrade, 'piggybacking', subscriber capitalisation and regional sharing of costs.

In order to finance membership of Intelsat, a financing plan was devised recently to help countries needing capital to join Intelsat to borrow against future Intelsat earnings. The sum involved is the required Intelsat minimum investment share (about $850,000) for each new member country. Under this agreement, the future revenue distributions by Intelsat to members or, in this case, the capital Intelsat returns to members against the originally invested capital, serves as a guarantee that funds will be available.

Under the arrangements which have been worked out, Intelsat could, in case of default, make up the loan deficit out of the capital distribution. The Intelsat protection in this arrangement derives from the fact that at current rates in force, Intelsat's return on the capital component will typically be greater than the interest rate of the loan. Typically such loans will be paid off in about five years, at which point the new members would have their investment in Intelsat free and clear. The banks have also extended this agreement to cover the purchase of earth station equipment as well.

This arrangement has already interested a number of African countries, and Intelsat is talking to a number of banks to cover different aspects, such as purchase of space segment capacity as well as agreements for other regions of the world beyond Africa.

Training

Intelsat has given a very high priority to training, at both university and professional levels. Largely as a result of requests received for assistance in training, Intelsat reviewed the facilities that existed worldwide for earth station training. From this it was learned that there is a worldwide requirement for training in satellite communications and earth station technology, but there only exists a limited number of institutions providing such training. Recognising that the primary responsibility for training rests with each individual country, it was concluded that under the IADP, additional training, in the form of seminars, could be provided on location.

These seminars are held on a regional basis, and led by Intelsat staff. They include lectures, seminar manuals and other educational tools, along with interpreters to translate the lectures and materials into the three official Intelsat languages – English, French and Spanish. By the end of 1986, 17 seminars had been held in various parts of the world and 77 countries had participated.

The Intelsat Assignee Programme was established in 1965 to provide an opportunity for technical personnel nominated by signatory organisations to participate in Intelsat's executive organ activities. Assignees are given one-year appointments which, with approval from Intelsat and their sponsoring organisation, may be extended for an additional year. The specialised technical skills and expertise brought to the programme by assignees enable them to make valuable contributions to the organisation. Similarly the assignees benefit from a unique exposure to a specialised field, thereby increasing their potential to make future contributions to their sponsoring organisations. By the end of last year 108 signatory nominees from 25 countries had participated in the Assignee Programme.

Another programme, the Young Professionals Programme, was established in 1982 and allows 10 participants. This is aimed primarily at providing trained and skilled manpower for signatory organisations. Selection is made on the basis of an individual's qualifications, taking into account academic training, and evaluations by educational institutions and/or employers. Participants must be between 22 and 33 years old and nominees are offered a one-year appointment. The training is conducted on the basis of a specific curriculum developed for each individual position. Fifteen young professionals, representing 13 countries, had participated by the end of 1986.

Lastly, the Intelsat Scholar Programme, started in 1985, is designed to allow graduate students or those professionals sponsored by an Intelsat signatory to gain experience while working with Intelsat. Graduate level students, particularly with degrees in science, or communications engineering, are considered as the best candidates for this programme. Students may even arrange supplemental study at Washington DC area universities if desired. Three candidates were selected as the first participants in the programme, from Bolivia, the People's Republic of China and the Republic of Korea.

Conclusion

Intelsat is an organisation dedicated to expanding telecommunications throughout the world, to rich and poor, urban and rural areas. It is a well recognised fact that the development and expansion of telecommunications infrastructures plays an essential role in the economic and social development of nations. Contributing to the solutions of problems inherent in expanding telecommunications in the developing world is thus one of Intelsat's most important objectives in the next decade. The initiatives Intelsat has made, as outlined here, are a very important first step. Certainly Intelsat hopes that within the next 15 years – that is, by the 21st century – communications will be within the reach of every man, woman and child who walks this planet, and that the dream of an electronic global village will finally have been achieved. ☐

Table 1: Key performance characteristics of Standard D stations.

Antenna size:	typically 4.5 metres at remote locations; 11 metres at heavy traffic nodes
LNA:	user-selected; autotracking not required
G/T:	at least 22.7 dB/K (Standard D-1) at least 31.7 dB/K (Standard D-2)
Tracking method:	user-selected
Transmit sidelobes:	32-25 log0dBi
Polarisation capability:	left hand circulation poralisation up – right hand circular polarisation down or right hand circular polarisation up – left hand circular polarisation down (not simultaneously)
Voltage axial ratio:	1.3 dB (Standard D-1) 1.06 dB (Standard D-2)
High power amplifier:	user-selected
Modulation technique:	single channel per carrier/companded frequency modulation (Vista) or demand assigned multiple access single channel per carrier/companded frequency modulation (Super Vista) (both using 30 kHz spacing)

MAKING SATELLITES PAY THEIR WAY

by Marianne Lamblot and Daniel Malègue

Investment in a satellite system is a major consideration for any country, involving estimates of current and future communications traffic. Yet proper use of new technological advances can ensure profitability. Marieanne Lamblot and Daniel Malègue of Aerospatiale at Les Mureaux propose some commercial applications for satellite systems.

THE economic growth of a country is closely linked to its potential expansion in the field of telecommunications. And in order for the latter to be successful, adaptability has to be a major consideration in the planning stages.

To date, the space industry has fulfilled these requirements. Compared to terrestrial communications systems, satellites provide:

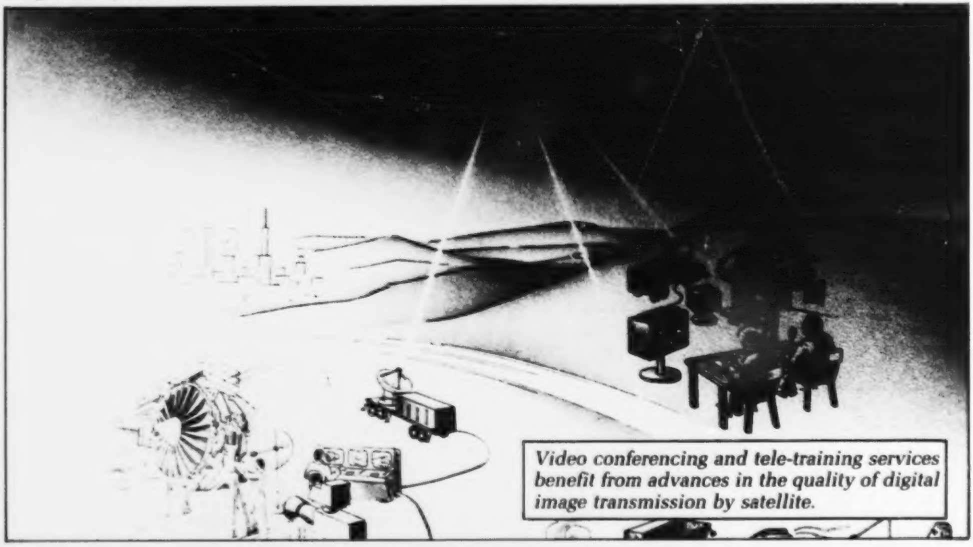
☐ immediate and total coverage of a vast territory;
☐ coverage of distant, mountainous or isolated regions with the same performance as for highly-populated areas;
☐ competitive prices for installation and system operation;
☐ increased operational security (ground networks are often placed in difficult and vulnerable environmental conditions);
☐ growth potential and flexibility.

Before a country decides to implement a space telecommunications system, it has to think in terms of cost and profit-earning capacity. The first step is to evaluate the needs of conventional services such as telephony, telex, point to point data transmission, etc. For this, a transponder on board an existing satellie may be rented and a ground network of transmission-reception stations set up.

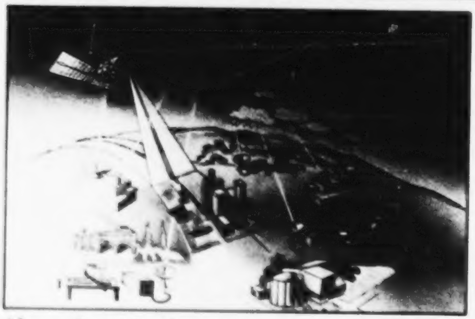
At a later stage, a country may decide to invest in its own satellite system. If this is the case, an estimate of the likely growth in traffic should be made, so that the power on board and the communications payload match real needs. The lifetime of a satellite is over 10 years and the cost is the same whatever the traffic.

At this stage, once the current and future requirements of conventional services have been established, the aim will be to make the system profitable. This can be done by adding new specialised applications to the range of services available, making use of new technological developments. For instance, special business services could be introduced which would reach the customer directly without going through an authorised network, the customer rather than the satellite operator having made the investment in the ground station.

The kind of technological advances that



Video conferencing and tele-training services benefit from advances in the quality of digital image transmission by satellite.



***Above:** Specialised services such as image processing can greatly enhance a system's profitability.*

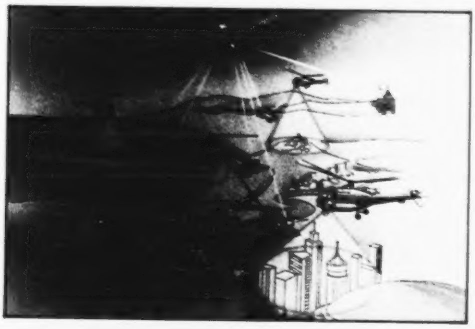
have made these services possible are as follows:

☐ satellites with multiple access;
☐ transmission-reception stations which give good performance with smaller antennae, at a lower cost and often with less complex technology;
☐ improvement of data processing systems, which now use microcomputers with high storage capacity;
☐ development of accessible software for various applications;
☐ digital image transmission.

In order to provide these additional services, two types of network could be considered: mesh networks and star networks.

In the case of mesh networks, the signals are directly transmitted to the customers, from the customers to the satellite, or from one customer to another via satellite. This configuration requires high-power transponders (30 dBW) on board the satellite, so that the investment in individual ground stations will not be too costly. An antenna 2.5 metres in diameter will be used for business services. For digital image transmission, a 4-metre antenna with a 30 dBW transponder will be required. Medium-class satellites such as Arabsat can provide this kind of service.

***Below:** Surveillance systems use aeroplanes or helicopters equipped with image-taking devices which are directly linked to small mobile ground stations. These then transmit signals via satellite to remote control stations within the satellite's coverage zone.*



In a star network, the signals are transmitted from the satellite to a hub station and then distributed to the different users' small terminals via satellite. This configuration requires less powerful transponders on board the satellite (25 dBW). The diameter of the ground station antennae would be 5 metres for the hub station and 1.5 metres for the terminals (for business services using C-band).

The business services to be provided could include:

☐ data exchanges between computers;
☐ information distribution services;
☐ remote sensing data distribution;
☐ teleprinting of newspapers;
☐ sending documents by facsimile;
☐ financial services;
☐ direct sales such as distribution of products.

The digital image processing services could include video conferencing, tele-training and tele-surveillance. The latter uses aeroplanes or helicopters equipped with image-taking devices, directly linked to small mobile ground stations separated by short distances of about 30 to 40km. The signals are then transmitted from the ground stations, via satellite, to remote control stations anywhere in the satellite's coverage zone.

Once conventional systems have been established, the new specialised services can be marketed. As the traffic of conventional services grows, using more capacity on board the operational satellite, the specialised services can be transferred to the system's back-up satellite. In this way, the traffic for specialised services will be guaranteed, whatever the growth of conventional services.

If the transponders used for conventional services should fail for any reason, these services will have priority over the specialised applications, however. This should not create a problem because a space system is highly reliable, with essential equipment on board the satellite having in-built redundancy. Studies of the availability of satellites have been encouraging, most being out of action for only one or two hours each year. Such a good safety margin makes it possible for specialised networks to take second place without being restricted in any way.

Using advanced technology in this manner, a satellite system can be made profitable. However, in order to achieve this, the organisation concerned must devote a part of its energies to exploring commercial possibilities and pursuing new ventures in order to attract specialised customers. ☐

EARTH STATION OPTIONS

by Brian Ackroyd

Increasingly, satellite communication is becoming the logical choice for countries wanting to set up a coherent domestic communictions network. Indeed, developing countries are often in a better position than industrialised nations to plan a flexible and cost-effective system from scratch. Brian Ackroyd, Assistant Marketing Manager, Space and Broadcast Division of Marconi Communication Systems Ltd, explains the principles behind earth station equipment.

EVERY country develops its communications infrastructure along different lines, despite the fact that there is international agreement, through the CCITT (International Consultative Committee on Telegraph and Telephone) and CCIR (International Consultative Committee on Radio), on the technical standards that everyone should follow. In fact, this should come as no surprise, since each country has its own special needs, depending upon its population, industrial or agricultural base, physical size and wealth. It is thus entirely natural that there should be no formal or rigid planning of communications networks and that they should grow at a rate dependent upon commercial as well as important strategic considerations.

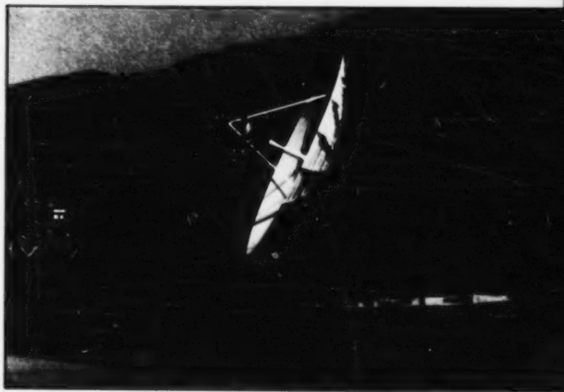
Traditionally, many countries have used high frequency (HF) for both internal and external communications. However, although this has improved considerably over the years

due to technological innovations, it still cannot provide the reliability necessary for the large channel capacities and data services that are now a major part of modern communications.

The requirements of both internal and external communications can now be met with a wide choice of new developments in multi-channel microwave, satellite and optical fibre systems, but it must be recognised that the same equipment cannot always be used for both. Trunk microwave routes, for instance, while suited to in-country links, are obviously not suitable for external links.

Cable, and more recently, optical fibre systems, have played a major role in the growth of local and international communications, though this is of little value for intercontinental traffic if the country is land-locked as well as being costly to install for internal routes.

Left: *The size of earlier Standard A earth stations made them a costly investment. The new Intelsat standard requires an antenna just over half the size.* ***Below:*** *A Standard B earth station uses a torque post mount and straightforward tracking methods.*



There is little doubt therefore that, for flexibility and cost, the use of satellite communications has many advantages over all other forms of multi-channel telephony/data systems for point-to-multi-point applications (or even point-to-point when distances are large).

Service availability is also crucial. The satellite user can link into a worldwide network, covering over 170 countries, by becoming a member of the Intelsat organisation and building the appropriate earth stations, which can then link into the countries' internal networks.

In fact, it can be argued that developing countries have a positive advantage over those with an existing, but haphazardly developed, communications network. Satellite communications now present them with the opportunity to set up a coherent domestic trunk communications system, covering the entire country, at a reasonable cost and in a short timescale. In addition, a domestic satellite system can be expanded easily to meet increasing demand.

It is not even necessary for a country to have its own satellite, with all the attendant costs of satellite launch equipment, insurance, ground control systems and spare satellites, although countries such as Brazil, Indonesia and India have made this investment. Since 1974, Intelsat has leased out spare satellite capacity for domestic purposes and at least 27 countries have taken up this offer. Whereas there was always a possibility that the lease could be terminated (this only happened once in 11 years), since 1985 these leases have become non pre-emptible. It is also possible to buy transponders from Intelsat, as Iran has done (see article on Intelsat services on page 324).

Below: *The equipment accommodation plan for a rural earth station in Iraq: the general layout of a satellite earth station is similar, regardless of its size.*

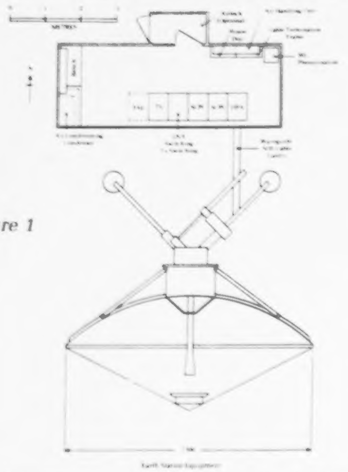


Figure 1

The leased space segment of Intelsat is only defined in very broad terms, i.e. those parameters that affect the interference levels due to sidelobes, polarisation, carrier frequency tolerance and spurious emissions from the earth station transmitters. The other main parameters, such as maximum EIRP (equivalent isotropic radiated power), modulation method and gain/noise temperature, are left to the users to define, giving them maximum freedom to produce the best system for their needs. Even so, the final design chosen has to be approved by Intelsat in order to ensure that it does not adversely affect other satellite users. Earth station design, for instance, remains within tight limits to avoid the service being degraded and the lease of the transponder being brought into question. In addition, the lessee has to take account of possible future changes in satellite configuration in his design.

External communications

Access into a country's telecommunications system, allowing for all forms of service such as voice, data, video, facsimile and telex, is provided by three standards of Intelsat earth stations: Standards A, B and C. The choice is determined by the amount of traffic required and the satellite resources available.

A Standard A earth station is appropriate for countries with large traffic requirements. In the past this needed an antenna 32 metres in diameter with a very low noise receiver front end. The size of the antenna made these very expensive, especially as the large reflector structure had to be stiff to maintain tracking accuracy but also had to be sufficiently mobile to be set up in a new position if necessary. However, a new Intelstat standard means that a much smaller antenna (between 15 and 18 metres in diameter) is now required.

A Standard B earth station, with an antenna 11 to 13 metres in diameter, is used where traffic requirements are small. Here the antenna is very simple using a torque post mount and straightforward tracking methods. The low noise receiving system is also much simpler and cheaper, using Peltier cooled low noise amplifiers (LNAs) of much reduced noise temperature.

The new Standard C earth station, not used extensively, is 11 metres in size. It uses the Ku-band in the 11 to 14 GHz range.

The overall layout of any earth station is similar, regardless of its size, as shown in Figure 1.

Internal communications

There are a number of possibilities specified by Intelsat for a network within a country, the final choice being dependent, once again, upon the services required. A Standard Z earth station, using the C/Ku-band, with optional modulation and antenna size of 4.5 to 18.3 metres, can be used for video, voice, data, facsimile traffic, etc.

Earth station configurations

The antenna is both the collector of the signal from the satellite and the radiator of the signal being transmitted to the satellite. It is itself an amplifier of the high-power amplifier (HPA) power, this gain increasing in relation to the diameter of the parabolic reflector. The antenna profile must be held to very tight limits in order to maintain system performance. Its radiation pattern is not ideal in that it is not focused into a single beam, but also radiates on sidelobes at an angle to the main beam.

Antenna design should minimise sidelobe and maximise forward radiation to prevent interference with adjacent satellites, which will eventually be spaced only two degrees apart in their orbit. In any system the signal transmitted to the satellite has to be kept within strictly specified limits and the signal received has to be kept at a maximum to guarantee system quality. This would present no problem if the satellite held its absolute position relative to the earth station, but this is not the case. The radiated beam of small antennae, below about 5 metres in diameter, is wide enough to take account of satellite movement, but large antennae have to be provided with a means of tracking the satellite. The tracking system can either be manual (based on maximising the received signal), automatic (using a step track system) or computerised (the theoretical and actual satellite positions are compared in order to derive control signals). The tracking system can be controlled locally or from a remote position.

The quality of an earth station is defined by the factor G/T, the ratio of the system gain to the system noise temperature. The system design is a compromise between antenna size and LNA noise temperature – a practical solution which relates to a trade-off between antenna and LNA cost. The LNA noise temperature is limited in its lower value by cost. The antenna size and gain cannot be reduced too far as the EIRP then becomes limited.

The signal collected by the antenna is applied to an LNA system, which is connected in a 1 for 1 redundancy configuration. The amplifiers usually have a gain of around 50 dB, with the noise temperature being set by the overall system requirements, in this case 85°K. The system noise figure has two components: low noise amplifier temperature and antenna noise contribution. To ensure against failure when the terminals are unattended, the amplifiers are connected in a redundancy arrangement which automatically transfers from one amplifier to another if failure should occur. The usual method followed is for one LNA to be used as the main path, with a test signal being passed through the standby system to check its availability should it need to be used. The whole system is mounted as close to the antenna feed as possible in order to reduce signal losses and minimise system noise temperature.

The high-power amplifiers provide an output of 600 W, at 6 GHz, over the full 500 MHz bandwidth. The use of travelling wave tubes (TWTs) means that no retuning is required should carrier frequencies be changed. The power transmitted to the satellite is 59.6 dBW per channel. Two HPAs are used to allow both telephony and television to be transmitted; redundancy is achieved by making the television amplifier the telephony standby chain.

The up/down converter system is used as interfacing between the radio frequency (RF) and baseband equipment. The output from the LNA is divided into two paths using a passive divider, then applied to down converter shelves that translate the 4 GHz signal down to an intermediate frequency (IF) of 70 MHz, a standard interface to the single channel per carrier (SCPC) and television baseband units. The SCPC and TV input signals are applied to to an up converter that modulates the signal on to a 70 MHz carrier and translates them up to 6 GHz for transmission up to the satellite. The SCPC system uses companded frequency modulation (FM) processing to increase channel utilisation.

In addition, it is often voice activated, meaning that no carrier is transmitted if no speech signals are present, thus reducing operational costs still further. The channels can be pre-assigned or used on a demand assigned basis, in which case the satellite transponder is used most effectively and thus at a lower cost.

All earth stations have a control and supervisory system to tell the operator the status of the various sub-systems and allow them to control antenna positions and signal paths. For a Domsat (domestic communications satellite) system, terminals are often unattended, monitoring being done from a central control station by polling to check the status of each.

Finally, the earth station has to interface with the outside world. This is achieved either by multiplex/demultiplex equipment or directly into a line of sight system, being used as a backhaul link away from the earth station to a central point.

The equipment can be housed in a permanent purpose-built building, or in a suitable container, the latter often being the simpler and more efficient solution as it allows the equipment to be fully tested before being brought to the site. The station power supply should, if possible, be derived from the local mains supply, backed up with a diesel generator. Whatever the arrangements, it is essential that the power supply be reasonably stable and free from interference.

Any earth station is a matter of compromise, the choice of antenna size, HPA output power and system noise temperature all being seen as a trade-off between performance and cost. This is essential if the satellite system is to provide a cost-effective solution to a particular country's communications needs. In addition, it is obviously preferable if the satellite can be dedicated to the specific domestic system and be specially designed to provide all the facilities and services required. □

OPTIONS FOR SATELLITE TV DISTRIBUTION

by Louis N Anciaux

Decisions about how to distribute a television service to a community depend upon the transmission facilities available and the potential costs involved. Comparisons have to be made to find the best use of equipment, taking into account possible future expansion. Louis N Anciaux, President of the Communications and Systems Division of the Californian company Lunar Industries Inc., considers a range of possibilities for television coverage.

THERE are many possible alternative solutions to the problem of distributing television programmes within a designated area. Of these, however, the use of satellite transmission is becoming increasingly popular, especially in developing countries.

Once the option of satellite transmission has been chosen, a decision then has to be made as to which satellite should be used out of those available for a particular region. The choice depends on several inter-related factors concerning equipment, efficiency and cost.

For instance, in the Middle East, southern Europe and North Africa region, either Arabsat with its very strong signals or one of the Intelsat series with its much reduced signals could be considered.

Arabsat

The use of the Arabsat satellite allows use of modestly sized uplink facilities and power, due to the strong footprint in the Gulf region. The dish may be a quarter to a tenth of the cost of the size required by an Intelsat satellite. The output power required is also modest, which allows the transmitter cost to be lower than for an Intelsat installation.

The downlinking facilities could use a dish as small as 2½ or 3 metres in size. Ideally, however, the dish for use in a retransmit system in this case should be at least 3½ metres to allow for system degradation, as well as to ensure high-quality reception at all points.

The local transmitter of only a few watts power sends the signal received from the satellite receiver system into the local community. The use of such local systems keeps every community separate, and makes the overall installation of the systems somewhat easier, since overground linking is not required. The logistics of handling many small systems, each a self-contained unit, is well within the abilities of a trained local installation force. Indeed, a complete system may be carried to the remote site in the back of a small truck with ease.

The individual homes within the local area may simply use a standard television set to receive their own channel. The simple system may also allow a locally originated programme to be run, by using either a video cassette recorder (VCR) or a video camera as input to the transmitter. This gives each village a means of sending out their own programme about local events and issues.

Once the exact system desired is determined, the problem of encoding and decoding the signals can be sorted out.

Intelsat

The use of an Intelsat satellite for distributing television programming may be accomplished as with the Arabsat scenario. However, since the signal levels from Intelsat satellites are usually quite a bit lower than the Arabsat signals, the dish requirement for the uplink transmitter may be a great deal more substantial. The transmitter power must also be higher and therefore more costly than that required for the Arabsat system.

The downlink dish requirements are substantially greater than those for Arabsat, with dishes up to 7½ metres possibly being needed to receive the Intelsat signals. The availability of inexpensive dishes that have the required performance and reliability is virtually nil.

A local transmitter could be used in conjunction with a large dish as with Arabsat. However, due to the considerably greater cost of the large dish, this system becomes rather impracticable for smaller villages. An alternative approach would be to use a large dish in a central location with a moderate power transmitter. This transmitter could also relay to many other surrounding villages using a small terrestrial distribution system employing translators.

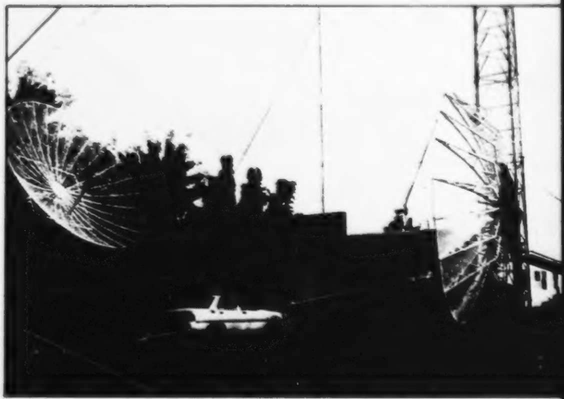
These would be installed at appropriate locations. The signal from the main transmitter would then be received by the translator, changed to another channel and transmitted to another site for viewing or to another translator for further distribution. The use of a series of translators allows the greater expense of the large dish to be spread over a larger number of villages. The translator systems costs are not significantly greater than a local transmitter system. The effect is that the distribution costs are nearly the same as for the same number of individual systems using Arabsat.

One additional item in favour of using the Intelsat system arises from the apparently lower satellite transponder fees being charged by Intelsat. The fees currently charged by most satellite carriers, including Arabsat, run in the $1 million to $1.5 million per year range. Intelsat is apparently unable to sell its lower power transponders readily, and substantial discounts have been seen.

***Above:** The towers and satellite dish for a 4 VHF channel system 20 W per channel, situated at Rupert House, Quebec, Canada, at the south end of James Bay. This provides television for a village of 3,000 inhabitants and reaches out to other small settlements up to 20 miles away.*

Basic system layouts and examples

Arabsat – Equipment requirements must be determined from the demographics of the site installation. Typically a system might consist of a 5-metre dish antenna with a medium power uplink transmitter. This capability will provide video via one of the 6 GHz uplink transponders on Arabsat.



***Above:** The tower and satellite dishes for a 7 VHF channel system, 5 W per channel located at David, Panama. This provides pay-per-view entertainment television for a town of over 40,000 inhabitants, with coverage extending over 15 miles in some areas because of the terrain.*

Downlink equipment within the major signal area of the Arabsat footprint could effectively utilise a 3-metre dish. A 3½ metre dish is preferable for the reception of high-quality video which is then transmitted into the local community with a low power transmitter. For the majority of small communities, a 1 or 5 W transmitter with an omni-directional antenna mounted on a small push-up mast will suffice for providing television to the community at a range of several miles. For greater coverage the transmit power and antenna may be raised.

In the event that there is no local source of alternating current (AC) power, a battery-powered system may be employed. This is particularly advantageous for very small communities where a single television set might be employed to provide several hours of entertainment for the villagers. A solar power battery charging system would recharge the batteries during the daylight hours to provide sufficient energy to power the TVRO receiver and television set for a number of hours in the evening.

A further advance on the battery power or solar power system could be a system sufficiently large to provide transmission capability to a community which has a large number of battery-powered television sets.

With a small amount of training, local personnel could install and service these miniature television systems. Each installation should take about one or two days.

Intelsat – Uplink capability for a typical Intelsat service would require a 7-metre dish and a high-power transmitting system to effect the C-band uplink transmission to the satellite. The system is also capable of handling digital data transmission.

The downlink systems may be most economically addressed by installing a large dish, nominally 7 metres in size, at a central location within a population region. This single dish will be utilised to provide the television signal to a number of other smaller villages in the surrounding region.

A high-power transmitter of between 15 and 100 W, depending upon the demographics, will provide a television service for the local population near the dish installation as well as to several remote translator sites located five to 15 miles away from the main transmitter. Each of these translators will provide, on another channel, the same video information for a small population centre, or, as a point-to-point relay system, further extend the transmission to another village located some distance away. Several of these translation chains may be employed to distribute the signal from the single dish into a widely scattered number of small communities.

The demographics of the region to be covered in this way will dictate the specific equipment required. Consequently a site survey and engineering study must be carried out.

System costs

Since there is some engineering and site surveying required to effect any of these installations, the costs quoted represent nominal equipment costs only. Neither do they include installation costs. However, use of trained local personnel in both the case of Arabsat and Intelsat provision will reduce the expense involved.

Arabsat uplink equipment – This is modestly priced, ranging from as little as \$150,000-\$200,000 to no more than \$350,000. Dual redundancy in the transmission system will, of course, nearly double the price. Any extra specialised equipment, such as data or pagination equipment and/or a suite of test equipment to effect repair and maintenance, will add to the basic system cost. A complete suite of test equipment required to maintain the system effectively could range from \$50,000 for the bare minimum to over \$150,000.

Intelsat uplink equipment – This will employ a much larger transmitting dish and a higher power transmitter, the cost possibly reaching as much as \$500,000. Other accessories and test equipment would add costs as above.

Arabsat downlink equipment – Assuming a $3\frac{1}{2}$-metre dish and a 5 W transmitter system for each community, the cost could be in the order of \$10,000 to \$15,000 if there is a source of AC power. Battery back-up systems would add several thousand dollars to the price, depending upon the scenario involved.

Intelsat downlink facility – Assuming a 7-metre dish and a 50 W transmitter for a modest size community, the cost could run from \$30,000 to \$50,000. Five to 15 W translators, located strategically in the surrounding area, could each be installed for between \$10,000 and \$20,000 depending upon the demographics of the site. Providing battery and solar power would, of course, add several thousand dollars to the cost of each individual installation. Thus, to install a complete Intelsat reception system and a series of ten translators could cost about \$150,000, or an average cost per village of approximately \$15,000. This compares quite favourably with the Arabsat scenario of approximately the same price per village with individual installations.

***Above:** The satellite receivers, television transmitters and encoders for this Panamanian system. Each home requires a decoder/converter unit to receive the signals.*

Future expansion

Once a system is operational, it is relatively inexpensive to add additional channels and/or other services, especially if expansion has been envisaged from the outset. For instance, data and/or telephone services could possibly be implemented within the framework of a television redistribution system by satellite. There is also the capability of providing this service via terrestrial means, though the cost is usually considerably greater. The addition of encoding and decoding equipment may be effected at any time once an installation is complete, the actual type being dependent upon the desired level of security and the intended market.

The following five examples are designed to demonstrate some possible systems.

1. A single television channel is to be retransmitted into a small community of 500 people, located at the base of a steep hill, which blocks the television ,signal from the major city some 25 miles away. The city transmits a channel 10 VHF signal, which is viewable on the hilltop towards the city from the small community. There is a source of electric power on the hill, and the community is providing a small secure building to house the translator. The angular coverage from the hilltop towards the village is approximately 40 degrees, and the maximum distance to be covered is approximately four miles. The channel is to be retransmitted on channel 13.

The basic system requires a small VHF-to-VHF translator. A single five-element Yagi antenna, with beamwidth in excess of 45 degrees, will allow good coverage of the target area. If a worse case receive antenna gain of only +3 dB is assumed, approximately 7.5 W equivalent isotropic radiated power (EIRP) is required. This further assumes a grade B level signal. Using a five-element Yagi for transmission, a 1 W translator would just be adequate. For a safety level to allow for ageing, reliability and less than ideal reception, a 5 W translator is recommended.

The basic equipment (excluding installation and follow-on maintenance) likely to be required is:

☐ one channel 7 and one channel 13 Yagi – $250 each
☐ one channel 7 and one channel 13 5 W translator – approx $2,700
☐ set of coaxial cables for above – $300

Total equipment costs – $3,500; installation – between $500 and $1,500 depending on several factors.

Obviously, if the building is not included, it will drive the cost up a small amount. Likewise, the installation can be a significant portion, especially if the site has difficult access, etc.

Let us assume there is another village 10 miles away, which has a clear shot from this same location, and an angular coverage of 20 degrees. If a 10-element Yagi is used, and the receiving end (i.e. the other village) is required to use decent outdoor television antennae, the 5 W signal can be split between the two antennae, and still have enough power to feed both villages. If the receiving antennae are not very good, the transmission power and thus the cost will go up.

The cost of adding this second village to the system would be a maximum of $500. However, if the village receiving end only uses 'rabbit ear' antennae, for instance, which really cuts the signal, and if the transmission end used a single 5-element transmission antenna, the power would be up to 50 W, which could add about $5,000 to the cost of the system.

2. A village with a popultion of 2,000 is located some 80 miles froma major city. The television signals on channel 34 are not visible on any of the surrounding hills. However, some 15 miles nearer to the city there is a mountain that does have low signal reception of channel 34 which can be seen easily by the village. There is also another village seven miles from the mountain in another direction that would also like to receive the signals, but whose view of the mountain is blocked by a small hill. There is alternating current (AC) power available at the top of this hill and 700 people can be seen within a 70 degree angle. There is no electric power at the top of the mountain and solar power is used to provide electricity. Television is to be provided for the first, larger village on channel 22 and to the smaller village, where it is only required to reach a maximum of two miles, on channel 10.

The mountain top system will consist of the following:

☐ high gain receiving array for channel 34 – $500
☐ high gain transmission array for channel 22 – $1,000
☐ channel 34 to channel 22 translator (10 W) – $3,500
☐ small tower to handle arrays – $400
☐ small security building – $2,000
☐ solar panel array (no batteries) – $2,500
☐ coaxial distribution systems – $300

Total equipment costs – $10,200; installation – between $2,000 and $5,000.

The small hill installation will consist of the following:

☐ high gain receiving channel 22 array – $500
☐ low gain, broad angle channel 10 – $250
☐ channel 22 to channel 10 translator (1 W) – $1,800
☐ coaxial cables – $250
☐ small mast with guying – $100
☐ small security housing – $750

The mountain top requires additional equipment to support this village:

☐ high gain channel 22 antenna – $500
☐ coaxial distribution system – $300

Total equipment costs – $4,450.

The transmission system on the mountain top provides a small portion of its power to the array pointed towards the closer village. In this case, the smaller village is also using a translator in order to obtain the signal from the main system used to feed the larger village. This multi-hop translator system may be used to provide the same signals to a large number of viewers over large areas. The major disadvantage to this system (other than remote sites for difficult installation) is the loss of signal quality as the number of hops or translators used in series increases. Up to six or ten in series have been used with a fair degree of success.

3. Now consider a four-channel superband system, using satellite-fed signals for programme source. The four channels will be on superband, and omni-directional coverage is required for the desired customer base of 1,500 homes. They can all see the transmission site located on a high hill in the centre of the town. The maximum distance to be covered is six miles in two directions and otherwise four miles radius. Each home will use an outside antenna and a converter. The signal level from the satellite requires a five-metre dish. Tracking capability on the dish and higher quality TVRO receivers are also required. The initial stage will allow for 500 customers.

The equipment required is as follows:

☐ 5-metre dish, dual polar, low noise amplifiers (LNAs) – $8,000
☐ four TVRO commercial receivers – $8,000
☐ four 5 W superband transmitters – $6,000
☐ four superband omni arrays – $1,200
☐ coaxial cabling system – $1,200
☐ miscellaneous installation items – $500
Total headend equipment costs – $24,900

Customer equipment requirements:

☐ 500 converters with AC adaptors – $19,000
☐ 500 broadband superband antennae – $16,000
Total customer equipment costs – $35,000
Total equipment, less installation, tower and buildings – $59,900.

After six months, the customer decides to add sync suppression encoding to the four channels. This requires sufficient decoders to fit his 500 base, plus an additional 250 units.

☐ headend (encoding equipment) – $12,000
☐ customer decoders (all 750) – $31,500
☐ customer converters for 250 more – $9,500
Additional equipment costs – $53,000
Total purchases within one year – $112,900.

4.A weak satellite (Intelsat) channel is to be distributed by a developing nation. They wish to cover 50 smaller communities with five large dishes, each dish to cover a total of 10 of the small communities. The clusters are within a circular region, and the system is designed using a 100 W transmitter at the dish site and nine translators to cover the outlying villages.

The system consists of five identical systems. Each has a 7½-metre dish of high quality, plus the required electronics for reception of a single channel, with redundancy built in to the receiver electronics. A single 100 W VHF transmitter feeds a gain array on a 30-metre tower. There are nine VHF translators used to send this signal to 14 villages. This is done as follows:

☐ one line has three 5 W translators feeding three villages and the other translators are in a single line.
☐ the second line has three 15 W translators feeding in line, with two of these splitting the signal to cover two villages each.
☐ the third line has a 50 W translator feeding a large village and also two split directions where a 1 W translator feeds another smaller village, and the other feeds a 5 W translator. The latter feeds its small village, as well as being picked up by a 15 W translator which uses a dual-directional array to cover the small village near the site plus two other small villages in opposite directions.

As this is a government-sponsored programme there is no encoding required. It is assumed the local agencies will provide the buildings and all electrical power is available at each site. The equipment is as follows:

☐ 7½-metre dish with actuator – $35,000
☐ dual receiving system all items – $8,000
☐ 100 W transmitter PAL format – $15,000
☐ 30-metre tower and array, cables – $12,000
Total headend equipment costs – $70,000
☐ one 50 W VHF-VHF translator – $6,700
☐ four 15 W VHF-VHF translators – $15,600
☐ three 5 W VHF-VHF translators – $8,100
☐ two 1 W VHF-VHF translators – $3,600
☐ 10 antenna arrays – $10,000
$44,000; total equipment costs – $114,000.

total equipment costs – $114,000.

5. Finally, consider a pay-per-view system with a large customer base. There are four 1 kW UHF channels, all transmitting from a single dish site. Only the RF side is to be addressed and the tower is on site. The four channels are to be encoded, using the pay-per-view system, and the initial number of customers is expected to be 5,000.

☐ four 1 kW transmitters – $220,000
☐ four high gain UHF arrays with cable – $24,000
☐ four encoders – $80,000
☐ high-calibre test gear – $100,000
Total headend equipment costs – $424,000
☐ 5,000 home decoders – $750,000
Total equipment costs – $1,174,000. ☐

GROUND RULES FOR SATELLITE TELEVISION

by John Donnithorne

Satellite technology has made it possible to receive television signals in all parts of the world with the use of appropriate equipment. The reception differs according to the orbital position and power of the satellite and the quality of the receiving system. John Donnithorne, Senior Development Engineer in the Space and Broadcast Division of Marconi Communications Ltd, explains the factors involved and gives a guide to the size of antenna required in different locations.

WITH the advances in satellite technology which have made high-power satellites a reality, and the availability of low-cost reception equipment, Third World countries are now showing great interest in the distribution of both television and data by satellite.

The major factors affecting satellite television reception in different parts of the world are:

☐ the output power of the satellite,
☐ the quality of the receiving system, known as the figure of merit,
☐ the orbital position of the satellite and hence its bearing and elevation from the reception site, and
☐ the climate in the reception area.

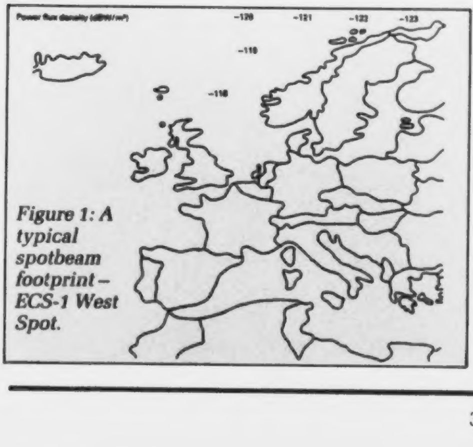


Figure 1: A typical spotbeam footprint – ECS-1 West Spot.

Satellite output power

Satellites are equipped with a number of antennae which radiate beams of energy to given points on earth. The level of energy decreases away from the centre of the beam (the boresight), and a map showing its distribution is known as the footprint. For instance, the two spotbeams on ECS-1 are West Spot (as shown in Figure 1) and East Spot, which is centred on Rumania.

Figure 1 shows the power flux density incident on the earth's surface. At the centre of the beam the satellite is transmitting an equivalent isotropic radiated power (EIRP) of 45 dBW, obtained from a 20 W amplifier and an antenna with a gain of 32 dB. This gives a half-power beamwidth of about 4°. The greater the gain of an antenna, the larger it has to be and the narrower is its beamwidth, resulting in a smaller area of the earth being covered.

For ideal reception on earth a large EIRP from the satellite is required, aimed at the reception area, allowing the use of a reasonably small receiving antenna.

In general, the closer the receiving antenna is to the edge of the footprint, and the lower the output power of the satellite, the larger the antenna has to be.

Figure of merit

This defines the quality of the system and is the ratio of the receiving antenna gain to the system noise temperature, expressed in dB/K.

The major contributor to the system noise temperature is the low noise converter (LNC), with temperatures at 11 GHz generally ranging from 120 K to 300 K.

For a given antenna, the lower the noise temperature of the LNC, the higher the quality of the system but, in general, the higher its cost. A typical system at 11 GHz would use a LNC with a noise temperature of 200 K. As a LNC usually has a gain in the region of 50 dB, there is a negligible contribution from subsequent stages in the receive chain.

Another contribution to the system noise temperature comes from the antenna, which picks up noise from both sky and earth. As the axis of the antenna is brought closer to the earth it picks up more man-made noise and the system is degraded. Such a situation arises when the satellite is at a low angle of elevation from the receiver site. At 11 GHz a typical figure of merit for a 3.7-metre diameter antenna receiving ECS-1 in London would be 26 dB/K.

Orbital position of the satellite

All television receive only (TVRO) satellites are located in geostationary orbit above the

Care must be taken to select the correct input match of the LNC, as it is possible to purchase a very low-noise temperature LNC which has a poor match, making it equivalent to a cheap, higher noise temperature LNC.

Satellite television receiver and associated equipment – The output from the LNC is conducted via low-loss coaxial cable to the equipment room where the receiving equipment is located.

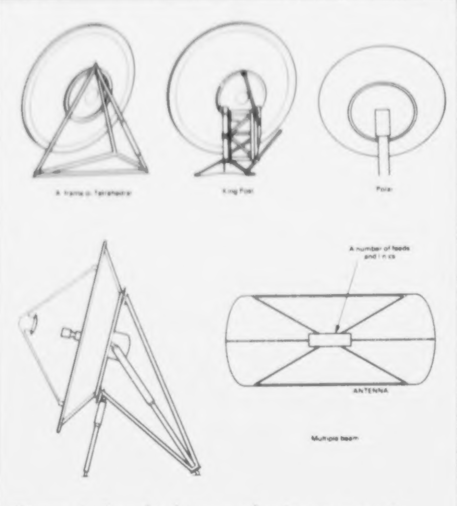


Figure 3: Standard types of antenna mount.

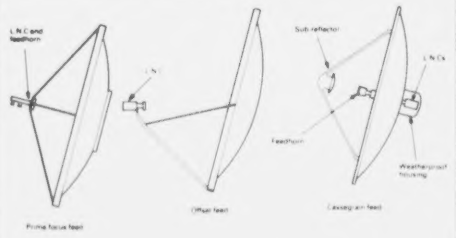
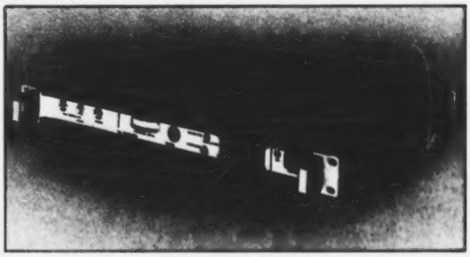


Figure 4: Types of antenna feed.



The unit would need to use a local oscillator frequency that will enable any frequency plan to be accommodated. The satellite frequency can be read directly from the front panel of the receiver, though sometimes only a channel number is provided, without direct reference to the satellite frequency.

To demodulate the signal, a threshold extension demodulator is usually used with excellent linearity in order to give high-quality video for optimum signal to the cable distribution network.

The LNC is usually powered via the signal coaxial cable from an auxiliary power supply. If more than one channel is required, the signal must be split by an active or passive splitting system. In addition to the receiver, power supply and splitters, it is also necessary to have equipment such as modulators and supervisory equipment in order to have a complete satellite head end.

Worldwide satellite television reception

In this section, information on a selection of satellites is presented, including the EIRP and the receiving antenna size typically required. For the estimation of antenna size, the following assumptions are made:

☐ the system noise temperature is 280 K at 11 GHz/12 GHz and 100 K at 4 GHz

☐ the received carrier-to-noise ratio under

Table 2: SBTS (Brazilsat): Brazilian domestic satellite television. Orbital position 65°W, 4 GHz band.

Receiving location	Satellite EIRP (dBW)	Diameter of antenna (metres)
Rio de Janeiro, Porto Alegre, Manaos, Salvador, Paramaribo	38	3.7
Montevideo	36	4.5
Trinidad	32	7.3
Bogota, Santiago, Lima	30	9.3
Falklands Is.	27	12

Programmes: Brazilian television network programmes.

equator. As stated in the foregoing section, the noise temperature increases with lower angles of elevation. This occurs when:

☐ the reception site is high in the northern or southern hemisphere. The satellite appears low in the sky and is also at a greater distance from the reception site, which contributes additional losses,

☐ the satellite is located in an orbital position well to the east or west of the receiving location. The maximum orbital distance between satellite and receiver again depends on the proximity of the latter to the equator. Given a perfect site, able to receive from satellites down to an elevation of 10°, then reception at orbital displacements shown in Table 1 is possible.

Table 1: Relationship of latitude to maximum orbital displacement.

Latitude	Maximum orbital replacement
0°	±71°
25°	±69°
51°	±59°
61°	±48°
65°	±40°

Climate

As already remarked, the higher the latitude of the receiving site, the greater is its distance from the satellite.

This contributes additional losses in the form of path attenuation, due mainly to water vapour in the atmosphere. Below 7.5 GHz the attenuation is negligible, except in regions subject to high levels of precipitation. When we reach the 11 GHz band large rain clouds can introduce significant attenuation of the signals. Meteorological data gives a figure for London of 30 millimetres (mm/h) of rain for 0.01 per cent of the year, but Mexico has 95 mm/h and the Philippines 145 mm/h.

These figures correspond to typical attentuations of 5 dB and 21 dB respectively for London and Mexico, while for obvious reasons the satellite which covers the Philippines operates at 4 GHz, where there is only about 0.75 dB attenuation. The peak of attenuation due to water absorption occurs at 22 GHz.

This form of loss also occurs on the transmit path. Some transmit earth stations are equipped to deal with this and the transmitted power can automatically be increased to overcome the loss.

The worst location for a satellite receiving station would be in a region of high precipitation, well away from the equator.

Design

A system can be broken down into three major areas:

☐ antenna,

☐ LNC, and

☐ satellite television receiver and associated equipment.

The antenna and LNC are located outside, while the receiving equipment is usually housed in a building. The LNC and receiving equipment are connected by high-quality coaxial cable (Figure 2).

Antenna – Not only does the size of antenna have to be carefully determined but the type of mount should also be chosen with care. The standard types of mount are shown in Figure 3.

The three types of feed available for TVRO are shown in Figure 4. An antenna may be fitted with a device to separate the horizontally and vertically polarised satellite signals (or right-hand and left-hand circularly polarised signals). If two LNCs are used, all channels available on the satellite can be viewed with the appropriate receiving equipment.

LNC – This device takes the incoming satellite signals at 4 GHz, 11 GHz and 12 GHz, or any other band if required, and amplifies them. The signals are then downconverted to a standard intermediate frequency (IF) of between 900 MHz and 1700 MHz. The LNC determines the system noise figure. TVRO system design usually involves trading the antenna size with LNC noise temperature. The lower the noise temperature of the LNC, the better it is and the better the system will be. As noise temperature drops the cost of the LNC rises, so this is another area of compromise.

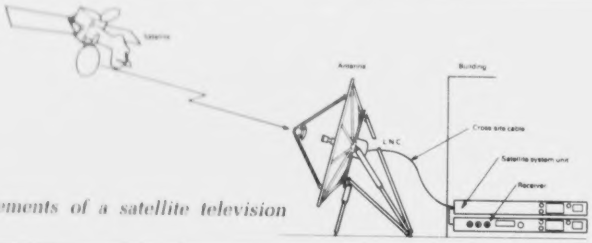


Figure 2: Basic elements of a satellite television receive system.

clear-sky conditions (no attentuation due to rain) is at least 16 dB; this provides a high-quality picture suitable for distribution on a cable television network. In areas of high rainfall the antenna size would have to be increased if the resulting degradation of signal quality was unacceptable.

Domestic and regional satellites

Information on SBTS (Brazilsat) and Arabsat is presented in Tables 2 and 3.

Australia: Aussat – Orbital positions 156°E, 160°E, 164°E. 12 GHz band.

There are three Aussats and many spot beams (see also page 50). The minimum size of antenna required at the centre of the most powerful spot beams is 1.2 metres in diameter, providing distribution quality pictures (16 dB carrier-to-noise). At the fourth contour of any spot beam a 4.5-metre diameter antenna is required. However, the fourth contour of the Central Australian Beam covers about one third of Australia. For the lower power spot beams a 1.8-metre diameter antenna is required at the centre and one of 5.6-metre diameter at the fourth contour.

The Continental beams are of lower power because they cover the whole of Australia and Papua New Guinea. At the centre of these beams a 4.5-metre diameter antenna would provide the required quality. In each case the third contour covers the whole of Australia and an 8-metre diameter antenna would be acceptable.

All television programmes are transmitted using B-MAC modulation. There are four high-power transponders per satellite for the Homestead and Community Broadcasting Satellite Service which provides television to remote communities who are out of reach of the existing terrestrial television network.

The programmes originate from the state capital city in each region. The remaining television transponders are for educational television and for the use of the Australian television networks (see page 406).

Indian region: Insat IB – Orbital position 74°E, 4 GHz and 2 GHz bands.

At 4 GHz the EIRP is 32 dBW minimum (7.3-metre antenna maximum). The 2 GHz band, used for community direct broadcasting by satellite (DBS) television, has 42 dBW minimum (3-metre maximum antenna). Programmes include national, educational and cultural items.

Indonesian region: Palapa B1 – Orbital position 108°E, 4 GHz band.

The 34 dBW contour (5-metre antenna) covers most of Papua New Guinea and the Philippines. The 32 dBW contour (7.3-metre antenna) covers the remainder of Indonesia and extends as far as Vietnam and Burma. Programmes are from the Indonesian Television Network.

International satellites

Table 4 shows the size of antenna required to obtain at least 16 dB carrier-to-noise ratio at a given location from a given satellite. Seven locations around the world have been chosen for this table.

Most of the spot beams can be steered to any

Table 3: Arabsat: Middle East regional television.
Orbital position 19°E and 26°E, 4 GHz and 2 GHz bands.

Band	Receiving location	Satellite EIRP (dBW)	Diameter of antenna (metres)
4 GHz	Riyadh, Sana, Aden, Addis Ababa, Cairo, Khartoum, Tripoli, Casablanca, Jerusalem	34	5
	Damascus, Baghdad, Tunis, Algiers	32	7.3
	Teheran, Athens, Sicily, Cyprus, Lisbon, Mogadishu, Madrid	30	9.3
	Bombay, Rome, Belgrade, Bordeaux, Dakar, Nairobi	26	12
2 GHz	This band is used for community television at locations through Northern Africa and the Middle East	41	3
Programmes – 4 GHz: regular television programmes and programmes exchanges between member countries 2 GHz: cultural, educational and information programmes.			

part of the globe which the satellite can see. The Atlantic spot beams are normally centred on Paris (East spot) and Washington (West spot). The antenna sizes given in the table for London and the United States apply to anywhere else on the globe if the spot beams are moved.

Although the Intersputnik satellite system, which has its headquarters in Moscow, is not dealt with in detail in this article, Gorizont 7 is included in Table 4 because it has a high-power spot beam which allows reception with small antennae in Europe. It is popular with language institutes and amateur satellite television experimenters.

The Intersputnik system was used extensively during the 1980 Olympic Games to send satellite signals from Moscow to more than 30 countries. Apart from receiving and retransmitting the UPITN news from London each day, via Intelsat VA FLO and Statsionar 4, there is little interchange between East and West.

Conclusion

It should be noted that this information is only a guide to the selection of the antenna. A particular site and/or system requirement may necessitate the use of a larger of smaller antenna. In particular, at frequencies above 7.5 GHz, rainfall plays a major role in the choice of antenna.

Amongst future developments, the next generation of international satellites (Intelsat VI series) will be more powerful than previous series, thus reducing the size of receiving station antenna still further.

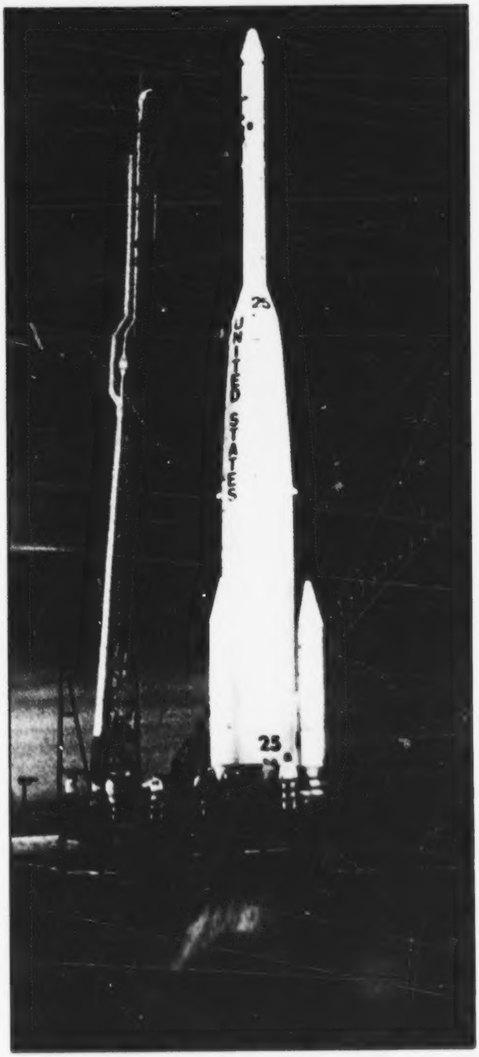
In addition, the arrival of true direct broadcast satellites within the next few years will mean that high-quality satellite television signals can be received using antennae of less than one metre in diameter. □

Table 4: International satellites – antenna sizes.

	Antenna diameter (metres) at different locations						
Satellite	**London**	**USA**	**Rio de Janeiro**	**Zaire**	**Bombay**	**Manila**	**Alice Springs**
Intelsat V F2 1°W	15 (G) 9.3(H) 4.5(11)	15 (G) 9.3(H) 3.7(11)	15 (G)	12 (G)			
Telecom F1 8°W	9.3(SG) 3 (11)	12 (SG)	15 (G)	12 (G)			
Gorizont 7 14°W	12 (G) 2.4(S)	12 (SG) 7.3(H)		9.3(H)			
Intelsat V F6 18.5°W	15 (G) 4.5(11)	15 (G) 3.7(11)	15 (G)	18 (G)			
Intelsat IV A F4 21.5°W	18 (G) 9.3(H)	15 (G)	15 (G)	18 (G) 9.3(H)			
Intelsat V A F10 24.5°W	15 (G) 4.5(11)	15 (G) 3.7(11)	12 (G) 7.3(H)	15 (G) 7.3(H)			
Intelsat V A F13 27.5°W	15 (G) 3 (11)	15 (G) 5 (H)	12 (G) 7.3(H)	15 (G)			
Intelsat IV A F1 31°W	18 (G) 9.3(H)	18 (G)	15 (G)	18 (G)			
Intelsat V F4 34.5°W	15 (G) 7.3(H) 4.5(11)	15 (G) 3.7(11)	12 (G)	15 (G) 7.3(H)			
Intelsat V F8 53°W	15 (G) 4.5(11)	15 (G) 5 (H)	12 (G) 7.3(H)				
Intelsat IV A F3 179°E		15 (G)				18 (G) 9.3(H)	15 (G) 9.3(H)
Intelsat IV A F6 174°E		18 (G) 9.3(S)				18 (G) 9.3(H)	15 (G) 12 (H)
Intelsat V F1 57°E	9.3(H) 4.5(11)			15 (G) 9.3(H)	12 (G)	15 (G) 9.3(H)	15 (G)
Intelsat V F5 63°E	15 (G) 3.7(11)			15 (G)	12 (G) 9.3(H)	15 (G) 9.3(H)	15 (G)
Intelsat V F7 60°E	15 (G) 3.7(11)			15 (G) 9.3(H)	12 (G) 9.3(H)	15 (G) 9.3(H)	15 (G) 9.3(H)

Key to codes:
G = global beam
SG = semi global beam
H = hemispheric beam (i.e. the West Hemi Beam covers the western portion of the globe as seen by the satellite)
S = spot beam
11 = 11 GHz spot beam (all other listings in this table are at 4 GHz)

RACING TO GET SATELLITES INTO THE SKY



Japan and China claim to have developed rockets with lift capability to match that of the American Delta rocket seen here.

by Jonathan Moggridge

At a time when the communications potential offered by satellites seems infinite, the satellite launching industry in the West is having to recuperate from a year of disasters. Meanwhile, competition is increasing from the Japanese, Chinese and the Soviet Union. Jonathan Moggridge, Editor of *Communications Engineering International*, explains how this uncertainty is affecting one of the biggest markets for satellite communications – developing countries.

SINCE the world's first commercial telecommunications satellite was launched 22 years ago, satellite communications have come a long way both technologically and in terms of the public's perception of them. From being viewed initially by many as the plaything of rich nations, today satellites are clearly helping to bring the standards of the developing world's telecommunications systems closer to that of the developed world.

The first frequency band used in commercial satellite communications was C-band (4 to 6 GHz), which, because of the low power density of the signal, needed large, expensive earth stations or dishes which measured some 30 metres in diameter. In the late 70's, however, with the overcrowding of C-band and the inherent problems of its susceptibility to interference from terrestrial microwave sources, a factor that prevented earth stations from being sited in urban areas, there was a move towards transmission on Ku-band (11 to 14 GHz). By increasing the power density of the signal transmitted via satellite, the size and consequently the cost of earth stations could be reduced. This brought satellite communication, with its insensitivity to distance and its point-to-multipoint transmission capabilities, within reach of developing nations. In addition to reducing the cost of a satellite network, transmission on the Ku-band offers greater flexibility as its signals are not hindered by interference from terrestrial microwave sources. Consequently earth stations can be sited in an urban environment.

Despite these advances, however, satellite communications have not been without their problems. Although they are more affordable and offer a wide range of applications such as mobile communications, direct broadcasting by satellite (DBS), maritime/aeronautical mobile services, data transmission, video conferencing and so on, the industry has entered a period of uncertainty, which is affecting the developing world in particular.

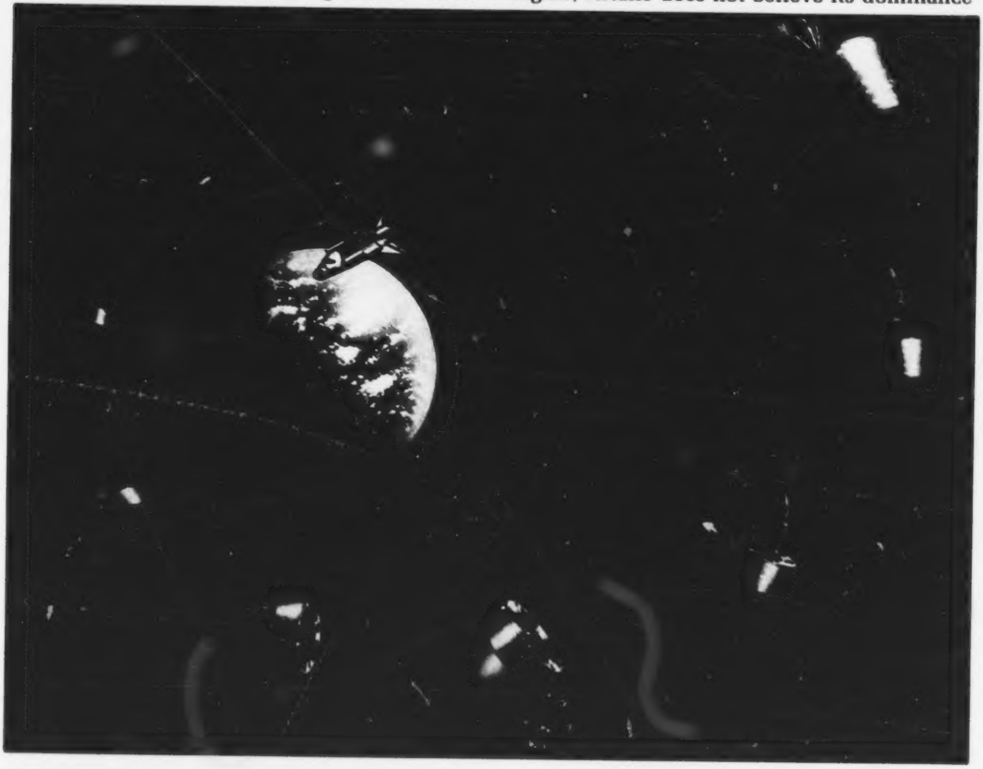
In the annals of satellite communications' brief but eventful history, 1986 is likely to be remembered as one of its darkest moments. The year began inauspiciously with the tragic American space shuttle disaster which killed seven astronauts and grounded all shuttle launches until February 1988.

The United States was not alone in suffering a setback Ariane, Western Europe's satellite launcher, was also dealt a severe blow in 1986. Endeavouring to strengthen its position in the international launching market in the wake of the Shuttle catastrophe and the suspension of all NASA launches following a series of accidents that befell its Delta and Titan rockets, Ariane experienced several abortive missions which led to the suspension of flights in May last year. However, the year ended on a high note for Ariane, after an extensive inquiry found that the cause of the launch failure was a faulty component and not, as many had feared, a major design fault.

American fortunes were, unhappily, not to receive such a fillip. In the summer it was announced that when the shuttle flights resumed they would be exclusively for scientific and military applications, thus putting the onus on the American private sector aerospace companies to provide launch facilities for the commercial market. Unfortunately, for some years the American government had tacitly been discouraging the private sector from competing in this field, promoting the re-usable as the most cost-effective method of putting satellites into geostationary orbit. Today, having received the green light, American companies such as Hughes, General Dynamics and Martin Marietta are returning to the tried and tested expendable type of rocket and find themselves in the unenviable position of starting the race from behind. They are unlikely to have any rockets operational before 1989.

Many observers feel that this situation has contrived to establish Ariane as the world leader in the space launch business in a market forecast to be worth $1 billion by 1990. Yet despite having sold space on all its planned flights, Ariane does not believe its dominance

***Below:** The launch sequence of the Hughes 399 communications satellite making its way into geostationary orbit, 35,800 kilometres, or 22,300 miles, above the equator. During the sequence, the satellite's motor propels it into an elliptical transfer orbit. At the high point, or apogee, of this orbit, the motor is fired again, thus achieving a circular orbit.*



will last and foresees stiff competition from the Japanese, Chinese and the USSR.

Japan is rapidly emerging as a space power but is unlikely to become a key player until the 1990s. It has constructed a heavy booster launch capability on the Pacific island of Tanegashi comparable to the largest launch pad at Cape Canaveral and has developed a rocket, the H-1, that matches the capability of the American Delta launcher. Japan is also in the process of developing the H-2, claimed to rival the Ariane 4 rocket in power, for the early 1990s. The Japanese prefer to keep quiet about their plans in the commercial sector, but it is believed that they have held talks with prospective customers.

The Chinese have launched some 20 satellites since their space programme began in the 1960s. While most of these have been lightweight scientific or military spacecraft, the development of the Long March 3 rocket has given them a lift capability equal to that of the American Delta rocket. Furthermore, China has also secured some notable commercial successes with America, where a memorandum of understanding has been signed with Teresat, and Sweden, where the Swedish Space Corporation has reserved space for the launch of its Mailsat telecommunications unit. The price charged by the Chinese is claimed to be 15 per cent cheaper than that of Ariane or NASA.

Spurred on by China's success, the Soviet Union is also making a bid to enter the highly profitable commercial satellite launch business using a booster rocket, the Proton, that was first developed in 1962. Until recently, political factors have dogged the Russians' success in this field. Western nations were particularly sensitive about transporting high technology to the Soviet Union, fearing that the Russians could glean important technological secrets from the West's equipment. To allay these fears, the Russians have given an assurance that they will safeguard the security of Western satellite technology en route to the launch pad, allowing Western engineers to accompany the satellite to the pad at Tyuratan and oversee the installation of the rocket.

Since its first development in 1962, the Proton has undergone various refinements and the Russians can boast a highly creditable sequence of 35 consecutive launches without failure.

In an interview published in *Tass*, Mr Nikolai Ryzhkov, the Soviet Prime Minister, offered special discounts to Third World countries for satellite launching. At present the Russians say that a single launch of a medium-sized satellite will cost around $18 to $20 million – about half the cost of Ariane.

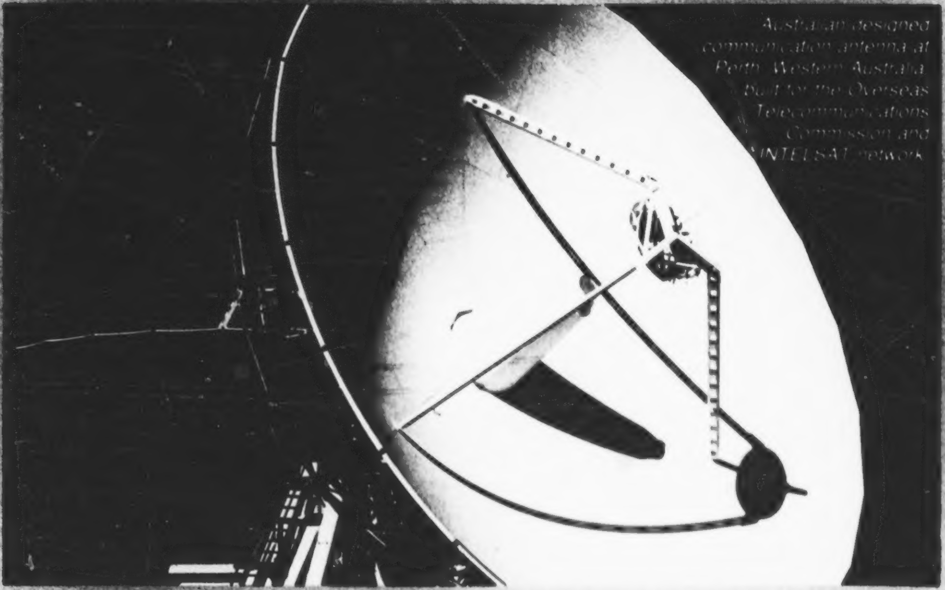
Although the Russians have not met with much success in the commercial satellite sector they continue to pursue various initiatives. Licensintobg, the Soviet hi-tech trading organisation, is expected to launch a Thai communications satellite which was brought from the American RCA Corporation. They also plan to launch India's IRS-1A satellie in the autumn of 1987 – the fourth Indian satellite to be launched by the Russians, but the first to reap the financial benefits of discount under the regime of the Soviet civil space agency, Glavkosmos.

Although the Chinese, Japanese and the Soviets are hoping to solve the problem of the launch hiatus caused by the failure of NASA's and Ariane's rockets, the impact of these events is still likely to be felt by the industry for some years to come, most notably by the newest entrants – the developing countries. Insurance premiums on satellites are likely to remain high, for instance. In the past few years they have risen from 10 per cent to 30 per cent of the cost of a satellite and could rise still further – a situation bound to have its repercussions in developing nations with their limited budgets. Secondly, a satellite that is grounded and in search of a launcher is not earning money for its would-be operators.

While these factors are a setback for the newest entrants, they are less of a problem for the established operator. Intelsat, for instance, although unhappy about the loss of a $51 million satellite on an abortive Ariane mission, is unlikely to lose any business. It already has an overcapacity, due mainly to the time-lag – sometimes as long as ten years – between the planning of a satellite service and its inauguration, and is selling off 160 transponders.

Developing nations are also dissatisfied with the allocation of space in the geostationary orbit – an orbit 36,000 kilometres above the equator where a satellite appears to stay stationary in the sky because its orbit is equal to that of the earth's rotation. With the wider variety of satellite services available to the end user and the intense competition in providing telecommunications services, the GSO has become increasingly overcrowded. Many developing nations feel the procedure for allocation in the GSO is biased in favour of nations that already operate a service.

Despite the fact that the satellite industry is clearly undergoing a period of change and uncertainty, as well as facing stiff competition from fibre optics, the market is continuing to grow. And with telecommunications networks in developing countries being required to cover great distances and hostile terrain – both ideal applications for satellite technology – its future is assured. □



Australian designed communication antenna at Perth, Western Australia. Built for the Overseas Telecommunications Commission and INTELSAT network.

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia is one of the largest and most diverse national research and development institutions in the world, with a staff of over 7000 in a hundred laboratories and field stations throughout the country. Its aims include the assistance of industrial growth and the application of science to enhance the living standards of the community. From within its staff, CSIRO can draw upon a large and diverse pool of individual skills that can be blended for scientific teamwork — a key to successful innovation and problem solving today. Of particular relevance to world communications are CSIRO developed satellite data reception and processing systems, and its activities in the field of information technology in general.

By its sheer size, geographic isolation, and sparse population, few countries stood to benefit more from satellite-based data and communications systems than Australia.

Groups in CSIRO concerned with mineral exploration and resource management were quick to realise the potential of the earth resources satellite and began, in the 1970s, to use Landsat data for a range of purposes that has continued to expand since then.

More recently, Australian researchers have also begun to use the data provided by other satellites, such as NOAA, GMS, GPS, and Nimbus, and have contributed to the development of systems for the operational use of spacecraft for communications, weather forecasting, earth observation, and mapping and surveying.

CSIRO remote-sensing R & D groups found very early in their work that, because of the reflective properties of the Australian landscape, raw Landsat images were not particularly useful for detecting subtle surface features such as those associated with particular types of mineralisation. They therefore set about devising optical and computing techniques for enhancing Landsat images. So began the development by CSIRO of powerful remote-sensing satellite data reception and image-processing systems, many of which have been commercialised or are available for commercialisation. Details of some of these systems are given in this article.

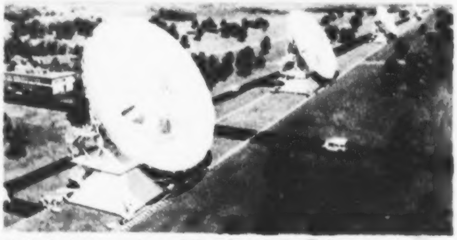
As regards communications satellites, right from the beginning Australia saw these spacecraft as a means of establishing closer, cheaper, and more reliable contact with the rest of the world. In 1964 it became, through its representative body, the Overseas Telecommunications Commission (OTC), one of the 11 foundation members of Intelsat, the International Telecommunications Satellite Organisation.

CSIRO and Australian engineering companies have already designed and built ground facilities to handle Intelsat traffic. This capability has arisen as a spin-off from CSIRO's position as a world leader in radio astronomy and the electromagnetic design of antennas, and expertise in microwave technologies built up over many years. CSIRO is also considering designs for new ground station and on-board facilities for Australia's domestic communications satellite system, AUSSAT.

The **CSIRO Division of Radiophysics** conducts research in radio science and electronic engineering and its application to industrial and community problems. To support its radio astronomy programs, the Division has developed considerable expertise in low-noise receivers, signal processing, and large reflecting antenna systems. This was stimulated by the design and construction of the Parkes 64 m radio telescope in the mid 1950s. Following completion of this telescope in 1961, the Division began a program of research into high performance antenna feed horns and work to upgrade the reflector surface for operation at higher frequencies.

The Division has been involved in a number of collaborative projects with industry and government agencies. Among the most notable of these was the conception and development of the **Interscan microwave aircraft landing system**, a system accepted by the international airline community for the 1990s.

Building on this experience, the **CSIRO Division of Radiophysics** and an Australian engineering company, **Macdonald Wagner Pty Limited**, have formed an antenna design team which has already brought two significant projects to the construction stage.



Artist's impression of the Australia Telescope

The first is the **Australia Telescope**, a radio telescope consisting of seven fully steerable 22 metre diameter antennas, designed to operate over a frequency range from 300 MHz to 115 GHz. This project is well advanced and due for completion in 1988.

The second is the design, supervision of manufacture, erection, and testing of three **18 m diameter Ku band antennas for OTC, for use in the Intelsat system**. Two of these antennas in Perth, Western Australia, were commissioned in time to relay the America's Cup races to the world at the beginning of 1987; the third, in Sydney, is nearing completion. The contract for these antennas, which meet Intelsat standards, was won against international competition.

The CSIRO-industry partners have introduced innovative and cost-saving

[illegible]

The work of the **Division of Information Technology**, established in 1984, falls under four major headings: Networking; Software Engineering; Devices and Systems Hardware Technology; and Spatial Information Systems. Many of its projects have relevance to the field of communications. The image processing software developed by the Division has already been described. The rest of this article covers other IT projects carried out in CSIRO, by the Division of Information Technology and various other groups.

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The Devices and Systems Hardware Technology Group of the Division of Information Technology is concerned with the research, development, and industrial application of integrated systems and circuits, and of software tools to facilitate the specification and implementation of systems and circuits.

An example of the work performed by the group is the implementation of an **industrial quality custom integrated circuit (IC)** for an Australian communications company, **J.N. Almgren Pty Limited**. This IC, which performs a switch function between a microprocessor and four concurrently active peripheral devices, was collaborative in that an Almgren engineer specified the function and a CSIRO IT research engineer designed and implemented it. A single 84-pin chip replaces approximately twelve ICs in an existing printed circuit board design (representing a reduction of 25% in board area), and is designed to save money in production.

[illegible]

The **CSIRO Division of Radiophysics** has actively pursued the opportunities offered by Very Large Scale Integration (VLSI) microelectronic circuits. **Austek Microsystems Pty Limited** has collaborated with the Division in the development of two chips.

A **multichannel correlator chip** consisting of 55 000 transistors has been designed and fabricated. The chip is destined for use in a large radio telescope system but could also find application in high performance spectrum analysers and correlation systems.

Currently nearing completion is a **Fast Fourier Transform chip** aimed at a variety of needs in image and signal processing, including filtering, spectral analysis, and equalisation. This design consists of 90 000 transistors and performs transforms some five times faster than currently available alternatives.

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CSIRO's commercial computing company **CSIRONET** has developed a powerful Network Product comprised of a number of hardware communications processors known as **micronodes**.

Each micronode contains multiple Motorola 68000 microprocessors, over a megabyte of memory, and up to 48 serial communications ports. Having no moving parts, the unit has very high reliability, and is capable of running in a wide range of environmental conditions. Each micronode is software-configured to perform a variety of functions. In general, a micronode performs either a Packet Switching Exchange (PSE) or a Terminal Interface (TI) function. A group of PSE micronodes developed and commercialised by CSIRO and a Melbourne company, **Microprocessor Applications (MPA) Pty Limited**. **MicroBRIAN** is a much extended version of BRIAN, a system originally designed to help survey Australia's 2000 km long Great Barrier Reef. This it did, in an extremely cost-effective way.

For around $US30,000, about half the price of its nearest competitor, **microBRIAN** brings to any company or authority concerned with managing large areas of natural resources the ability to process commercially available satellite data on its own facility.

The Centre for Spatial Information Systems of the **CSIRO Division of Information Technology** has produced an extensive suite of image processing software called **DISIMP (Device-Independent Software for Image Processing)** as part of its research and development activities. DISIMP provides comprehensive facilities for processing digital images from many different sources. These facilities include image restoration and enhancement, geometric and intensity transformations, statistical analysis and image classification, and interactive colour image display.

A major feature of DISIMP is its support for a variety of computer systems and for a wide range of peripherals including digitisers, interactive display systems, and hardcopy devices. Its common device interface allows DISIMP to be installed on a range of interactive image display systems.

Special facilities are provided in DISIMP for analysing multi-spectral images from the Landsat, SPOT, and NOAA satellites, and for integrating these images with data relating to topographic, geophysical, and cultural characteristics. The main applications of DISIMP have therefore been in the analysis of remotely sensed data and in image-based geographic data processing.

DISIMP is currently being extended with techniques for integrating image, graphic, and tabular representation of geographically referenced data. These techniques are being incorporated within an image-based geographic information system for vegetation assessment and monitoring, agricultural monitoring, and atmospheric data analysis and interpretation.

The DISIMP package is used in a second part of the **CSIRO Atmospheric Research** satellite data system, which is an extremely powerful image processing work station called the **Arlunya IW1000**, produced by the **Dindima Group Pty Limited**, another Melbourne company. The Arlunya IW1000 combines advanced 32-bit processing and display architecture with DISIMP and the University of Melbourne GKS package running under Unix V.2. It can be used as a research tool as well as for routine image processing.

CSIRO software is also used by a South Australian company **Quentron Digital Systems** in its recently released **QDS1000** image processing terminal. The **QDS1000** terminal is particularly suited to remote sensing applications and is designed to optimally support DISIMP. A feature of the terminal is that its functions are programmable, so it can be adapted to a wide range of applications.

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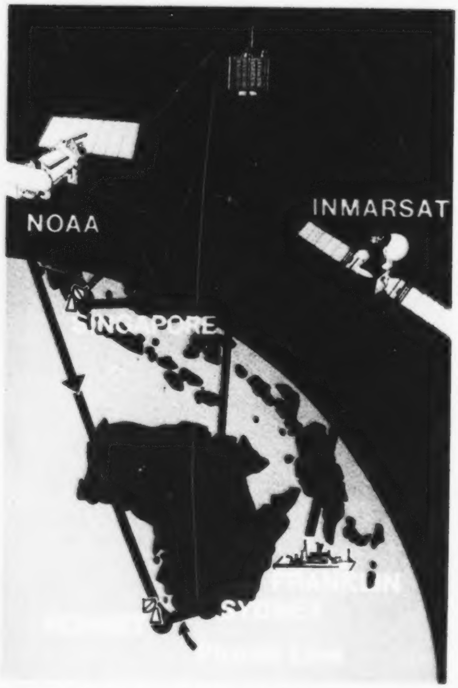
The **CSIRO Division of Oceanography** is upgrading the image processing facilities on its research vessel the 'Franklin', by installing a **QDS1000** terminal. During oceanographic cruises a great deal of effort and ship time can be expended in locating suitable sampling stations in relation to fronts, currents, eddies, and upwellings. Finding these features may, in many cases, rely on little more than trial and error. To overcome this problem, the Division began during 1986 to use NOAA satellite images of sea-surface temperature as a means of locating oceanographic features during research cruises. This is proving to be very cost effective.

The NOAA images are received by the Division's facility in Hobart, then transmitted to the RV 'Franklin' via INMARSAT satellite. Processed images are received by the research vessel within 6 hours of initial acquisition. During a cruise at the end of 1986 to study the East Australian Current a

microBRIAN — a powerful and versatile yet low-cost image analysis system developed by CSIRO in association with MPA Pty Limited.

A Quentron QDS 1000 image processing work station employing DISIMP software developed by CSIRO.



Australia's oceanographic research vessel, the R.V. Franklin, is equipped to receive data from the NOAA satellite, which is processed on land and relayed to the vessel via INMARSAT.

satellite image received on the final day revealed the presence of a large gyre to the north-east of Flinders Island in Bass Strait. An alteration in course took the vessel across the gyre at exactly the anticipated time. Features such as this would have been missed without the use of near real-time satellite imagery.

NOAA sea-surface temperature imagery is also being used by the fishing industry in the east and west of Australia. In the west, it has been found that bluefin tuna congregate near the boundary of the warmer Leeuwin Current with cooler waters. The satellite technology group in the CSIRO Division of Water Resources Research participated in the development of a system for sending processed NOAA imagery to the fishing fleet base via modem, to assist boats in locating the catch. In the east, the CSIRO Division of Atmospheric Research has a contract with the Trawler Owners Distribution Organisation to provide daily NOAA satellite imagery of south-eastern Australian waters.

Satellite remote sensing has played a significant role in the discovery of mineral resources in Australia, and the **CSIRO Division of Mineral Physics and Mineralogy** has been a leader in the development of the technology involved. Australia's first digital Landsat imagery was processed by the Division in 1975 and the lessons learned were used in defining the specifications for

CSIRO-developed remote data acquisition platform which uses the French ARGOS system on-board the NOAA satellites to retrieve the data. Seven of the platforms are already in use in remote locations throughout Australia.

the Australian Landsat Station, which became fully operational at the end of 1979.

In 1978, the Division built one of the first interactive image display systems in Australia, and began, in the early 1980s, to develop a more modern system based on the then emerging range of 32-bit microprocessors.

In 1986, as part of this hardware development and testing, the Division collaborated with the Division of Radiophysics and with the Department of Resources and Energy's Division of National Mapping to provide an experimental modification of the Australian Landsat Station (now the Australian Centre for Remote Sensing, ACRES) facility at Alice Springs so that it could receive **Landsat Thematic Mapper (TM)** data for a group of experimenters. Funding came from the experimenters themselves; a group of 36 private and government organisations, coordinated by the Australian Mineral Industries Research Association, which undertook the management of data distribution.

The experiment was a complete success, and marked the climax of a research and development program by the **Division of Mineral Physics and Mineralogy** that has yielded a set of inexpensive, flexible systems for the processing and storing of large digital images. The Division sees considerable commercial potential in these systems, and a licencee is being sought to manufacture and market the main products envisaged.

- a Landsat TM data decoder
- a real-time moving window display for TM data
- a quick-look product generator for TM data
- an intelligent file server for image processing
- an interactive, digital image display system.

The Division of Mineral Physics and Mineralogy has also developed **remote data acquisition platforms** that use the French ARGOS system on-board the NOAA satellites to retrieve the data. The platforms provide high mechanical and electronic reliability at minimum cost. Seven are already in use in remote locations throughout Australia, operating under extreme environmental conditions. They can function unattended for more than 6 months in both marine and terrestrial environments, have low power requirements, and are suitable for adaptation to a wide range of both analog and digital sensor systems. **Codan Pty Limited** has been granted a licence to manufacture and market them.

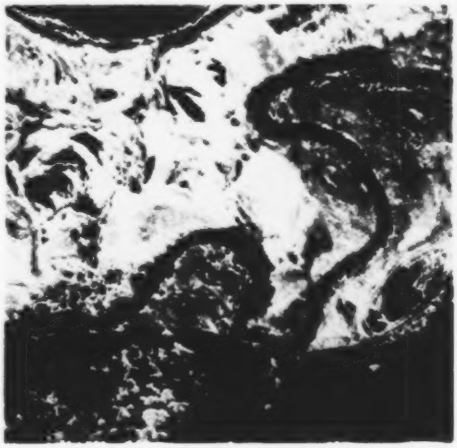


Image of the Mitta Mitta River taken during development of infrared scanners by CSIRO researchers. In this image warm areas of the river appear as red and cold areas as blue.

approaches to the design and construction of antennas. They have developed simplified models of dish behaviour and new computer programs to analyse the accuracy of dish surfaces deformed under various loadings. With these tools, the team has analysed a large number of configurations, progressively changing parameters, and gaining a 'feel' for antenna design which would otherwise have not been possible.

A major component of antennas is the paraboloid reflecting surface, which usually consists of doubly curved panels of aluminium. Because of this and because there was no existing source of antenna panels, the design team put considerable effort into developing, testing and refining new manufacturing techniques. The result is a method of manufacture which is very economical, requires only simple custom-made equipment, and gives the high surface accuracy needed to meet the stringent specifications for gain and side-lobe level performance. The method has been used successfully in two fabrication plants.

The CSIRO-industry group, with its combined knowledge in the areas of electromagnetic design and feed-systems, and of structural design and panel manufacture, is well placed to supply standard earth station antennas for the 6/4 and 14/12 GHz bands, and one-off antenna designs for specialist purposes.

Satellite Data Reception Systems

Three Divisions of CSIRO — **Atmospheric Research, Water Resources Research**, and **Oceanography** — have established reception and processing systems to satisfy their research needs for data from environmental/meteorological satellites. These systems are used primarily to receive data from the Advanced Very High Resolution Radiometer (AVHRR) on the U.S. NOAA satellites, and have greatly enhanced research and understanding in a number of important areas, including ocean current and atmospheric studies, minerals exploration, and the continental-scale quantification of vegetation growth.

The satellite data accession system developed by the **CSIRO Division of Atmospheric Research** is now being sold under the name **SAT-TRAC** by **PCM Electronics Pty Ltd**, an Australian company based in Melbourne.

The SAT-TRAC system is a complete ground station for the automated reception and storage of NOAA satellite data. It has four main sub-systems:

- antenna mount and motor control section;
- RF front end;
- instrument control rack;
- control computer.

The control computer calculates antenna pointing information from an algorithm which uses the latest orbital parameters as inputs. These calculations are performed before a satellite pass takes place. A set of pointing vectors is downloaded to a microprocessor-controlled module located in the instrument rack. This module, known as the antenna controller, constantly checks the azimuth and elevation of the antenna and compares the actual pointing direction with the previously calculated pointing vectors. The microprocessor adjusts the speed and direction of the motors in order to keep the antenna pointing at the satellite.

The antenna signal is amplified, down converted, demodulated, and decoded to produce the original satellite data stream. These digital data pass to the control computer where they are processed by special purpose hardware and stored on hard disk.

Image Processing Systems

Several CSIRO Divisions, working in collaboration with industry, have developed an advanced suite of software packages to meet the image processing requirements of the remote sensing user community.

A PC-based satellite image processing system called **microBRIAN** has been provides a high-performance redundant network interconnecting the TI micronodes via data links. Each PSE micronode has a capacity of 400 packets/second.

The **CSIRONET Network Product** forms the data communications heart of the **South Australian Justice Information System (JIS)**, which CSIRONET, competing in a market currently dominated by overseas companies, was recently awarded a $1.4 million contract to develop.

JIS will service the requirements of South Australia's law enforcement and related agencies through a single computerised information network. The network challenges are considerable. The project calls for the linking of over 240 terminals and attached printers in 186 sites scattered throughout the State to two computers in the capital. The CSIRONET networking solution is independent of the computer hardware selected, so there is no hardware limitation to the way the system might grow and develop in the future.

The CSIRONET micronodes are now marketed (as '**Ultranodes**') by **Network Automation Pty Limited**, a company formed as a joint venture of CSIRO and Techway. Network Automation was recently awarded a $2.3 million contract by the State Rail Authority of New South Wales to supply 84 Ultranode packet-switching network nodes for a major project to integrate the Authority's three main computer systems.

The Ultranodes, with their ability to link different types of computers and their individual networks, even when all use different protocols, were a logical choice. They will integrate the timetables and electrical branch system, on Hewlett-Packard equipment, with the rolling stock management system, on Tandems, and the reservations, personnel, locomotive maintenance, and administrative systems, on Sperry hardware.

The Acting Chief Executive of the State Rail Authority said that from its first full day of operation the integrated network will be able to support up to 1200 terminals and allow the introduction of new services such as videotex and the extension of reservation capabilities to independent travel agents.

Contacting CSIRO

CSIRO's commercial agent, business and legal adviser, [illegible] patent agent, and industrial property [illegible] is SIROTECH Limited [illegible]

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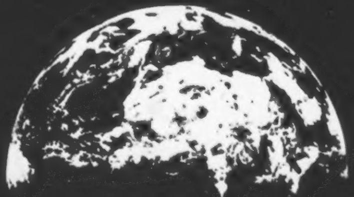

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WITH 25 years experience in international satellite communications, Scientific-Atlanta has installed over 13,000 C- and Ku-Band earth station systems. Through the design and manufacture of systems and products for over 75 countries, the company has acquired extensive knowledge in meeting the special communications requirements of each customer.

In recent years, Scientific-Atlanta has developed earth stations for a number of major world events such as the World Cup Soccer matches in Mexico City and the 1984 Olympics in Los Angeles, California. Scientific-Atlanta earth station equipment was also used to transmit coverage of the 1980 Olympics from Canada and will be used for the 1988 Olympics in Korea.

The company has designed and installed hundreds of earth stations now in operation worldwide via INTELSAT satellites and has also designed earth stations to operate with many of the world's domestic satellites including Palapa, Morelos, Arabsat, Aussat, Brazilsat, Insat, Anik and Eutelsat.

Scientific-Atlanta understands the technical requirements set forth by INTELSAT and other telecommunications governing agencies and the company designs compatibility with these standards into its products.

Scientific-Atlanta responded when INTELSAT began the development of VISTA, a low-cost service which would provide communications to remote communities not reached by conventional communications. To enhance the VISTA service, INTELSAT issued an international tender in 1986, to 200 potential earth station manufacturers in 21 nations. After extensive technical and cost evaluations, Scientific-Atlanta was selected to provide VISTA D1 earth stations to INTELSAT signatories and non-signatory users. The company was selected on the basis of price, system design, technical quality of field-proven components, and delivery time.

As a result, Scientific-Atlanta has introduced its new INTELSAT VISTA D1 Earth Station to provide high-quality, dependable communications capability to geographically isolated locations worldwide. The system is specifically designed to operate via the new INTELSAT service, which provides voice activated single-channel-per-carrier (SCPC/CFM) service at an economical per-channel lease rate. The user can purchase the exact number of channels needed for voice, low-speed data, facsimile, telex, teletype, computer-to-computer connections, or optional television receive service.

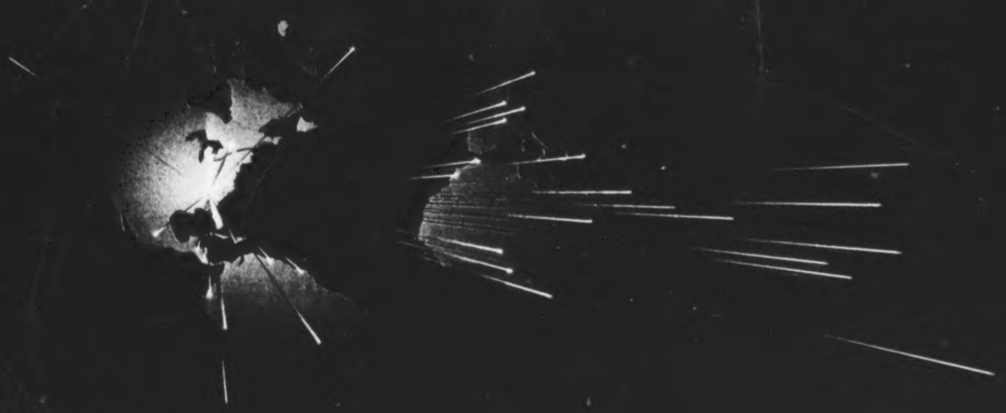
Other recent developments include B-MAC, the company's revolutionary satellite transmission format. Based on multiplexed analog component technology, B-MAC offers the ability to transmit broadcast-quality video, six channels of 204.5 kb/s data or audio, utility data and teletext, all simultaneously and securely, to individually addressable locations. The B-MAC signal is rugged, delivering perceptibly better video quality when subjected to increased noise due to rain fade or other adverse weather conditions. The signal ruggedness enables the receive sites to operate effectively with smaller antennas than would be necessary with the traditional NTSC, PAL, or SECAM transmission formats.

Acceptance of Scientific-Atlanta's proprietary B-MAC technology is growing worldwide for use in a variety of innovative applications. Private corporate networks transmit training programs, introduce new products and services and transfer data using B-MAC. Australia has adopted the technology as its national broadcast standard. B-MAC's signal strength and ruggedness were key to Australia's need for transmission to its vast outback.

As a result of Scientific-Atlanta's many years of experience, the company has the unequalled capability to provide complete satellite communications systems from original design, to the manufacture of components and subsystems, to system installation anywhere in the world. When needed, Scientific-Atlanta can also provide customer training, field maintenance, or nominal maintenance contracts.

To ensure responsive customer support, Scientific-Atlanta has subsidiaries in France, the United Kingdom, Italy, West Germany, the Netherlands and Australia, as well as representatives in another 30 countries. Regional sales managers based in Atlanta are available to travel worldwide to visit customers and to discuss specific communications needs. □

Scientific Atlanta



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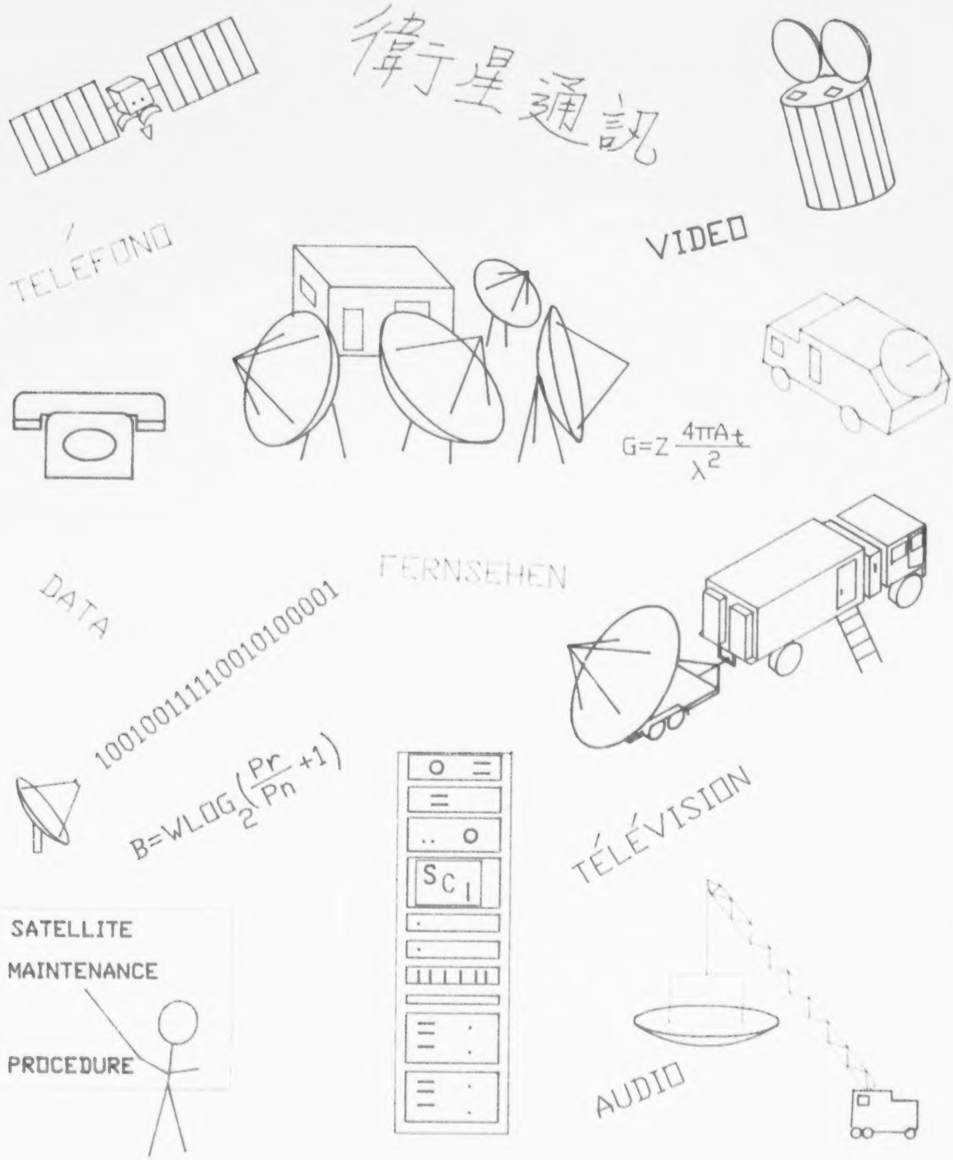
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Hubbard Communications Inc. is one of America's most important broadcast groups owning 7 television stations and 2 radio stations across the country.

In 1981, Hubbard was unsuccessful in finding a supplier of custom video equipment needed for mobile satellite communications — so the company formed HUBCOM to design, build and market equipment unavailable elsewhere.

In 1984 HUBCOM built the first SNG® vehicle in the United States and today the company has built more SNG® trucks than everyone else in the industry combined. In fact HUBCOM is the only supplier of Satellite News Gathering vehicles to the United States television networks.

Besides building the first SNG® vehicle HUBCOM has supplied the first C-130 air cargo vehicle and the first mobile, satellite X-ray development laboratory.

With the emerging capacity of both C Band and KU Band satellites on a worldwide basis HUBCOM is uniquely qualified to supply mobile and transporter satellite uplink systems.

HUBCOM's SNG® KU Band vehicles are designed to provide ease of mobility and rapid deployment so that they can cover fast-breaking news stories outside the normal 2GHz electronic news gathering capabilities.

Television station-operated SNG® vehicles are limited only by the satellite beam edge contour. This amount of coverage means news stories are able to be covered from anywhere within the continental United States.

In order to take full advantage of this capability of local stations to provide national news coverage, several networks have been formed to provide two wire, four wire and data links from SNG® trucks to their television stations. One of these networks, Conus Communications, another division of Hubbard Communications, now supports more than fifty SNG® affiliates on a daily basis using up to 5 KU Banded transponders on two different satellites.

In the three years since HUBCOM built the first SNG® truck in the United States, the company has delivered more than 50 systems to broadcasters, the medical industry, educational institutions and private teleports, including the first KU Band SNG® truck delivered to Japan.

PRODUCTS DEPICTED ON THE ADJACENT PAGE

SNG-VFP. HUBCOM's video flight pack is the answer to satellite news gathering missions around the world. Complete with all transmission and receive/monitor equipment, the SNG-VFP is packed in just eight aluminum shipping cases.

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With a set up time of thirty minutes for one person, the SNG-VFP provides for fast deployment in the field. The system is configured for non-redundant transmission of video, audio or data circuits.

551KS. This 5.5 Meter Parabolic Antenna System is typical of KU-Band receive terminals installed by HUBCOM. The company offers a complete turnkey service, providing equipment and installation of fixed uplink and downlink systems.

SNG-LB. This SNG® truck is one of five standard models offered by HUBCOM. It is designed to be air-shipped on C-119 or larger aircraft. The most compact vehicle of its type, the SNG-LB utilizes a 2.3 meter antenna and has an overall height of less than 8 feet allowing access to tight locations, low overpasses and many parking garages.

HUBCOM employs antenna mounted KU Band traveling wave tube amps for minimal waveguide loss. Seating for four (including the operator) is accommodated in the cutaway truck cab configuration. Ninety-six EIA standard rack units are provided for RF and customer supported equipment.

The vehicle is self-contained with a generator and AC/DC distribution and, like all HUBCOM SNG® trucks, it features a modular aluminum body that is easily transferred to another chassis when the original chassis reaches the end of its service life.

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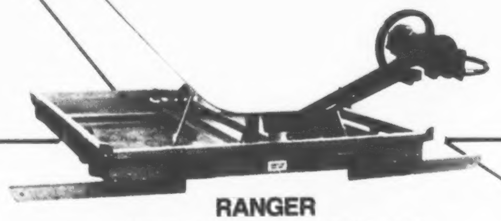

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VSAT AND NEWS GATHERING

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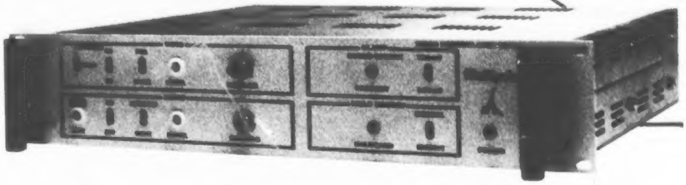

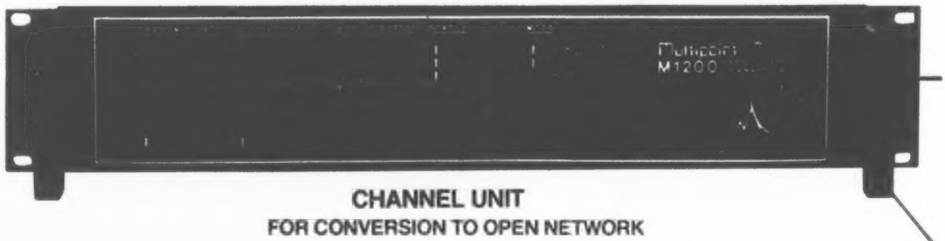

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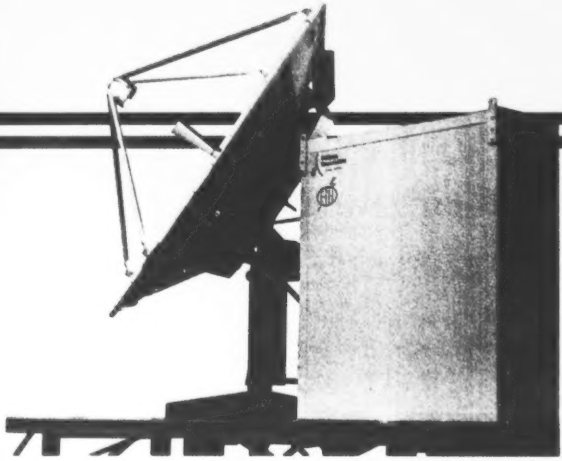

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FOR VIDEO CONFERENCING AND IBS DATA E1-E3

GENERAL

MULTIPOINT COMMUNICATIONS is a HIGH TECH British Company specialising in the design, supply, and commissioning of satellite earth stations for transmitting and receiving video, voice and business data over the Intelsat, Eutelsat and other national satellite networks. The Company was formed in 1981 and is supported by a highly professional team with a long pedigree in the field of satellite communications. The Company operates from a modern factory, fully equipped with a comprehensive range of test equipment, operational aerials, software and services necessary to support complicated projects.

COMPANY STRUCTURE

To ensure proper PROJECT MANAGEMENT and CUSTOMER SUPPORT the Company is divided into four product areas each with its own Product Manager, production team and marketing support. The product teams can be quickly enlarged for major contracts.

Central services include Drawing Office, Documentation, Purchasing, Financial Control and Administration.

The Company's quality control is to BS5750 and this has been vetted by several major customers.

ACHIEVEMENTS

MULTIPOINT COMMUNICATIONS has successfully completed a number of new initiatives in Europe. The Company was first to supply and commission a 12GHz satellite business network to Europe and has terminals operating in many European Cities. The Company was the first to install an INTELSAT IBS 'OPEN NETWORK' business link between Europe and the USA.

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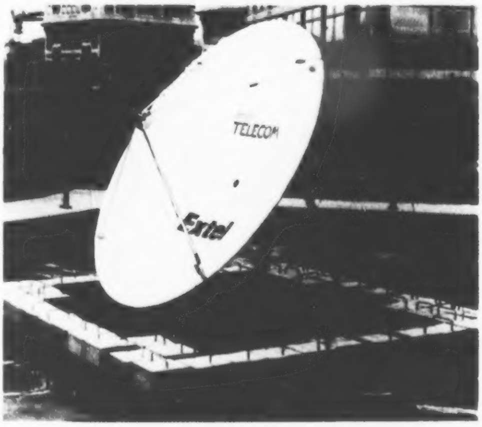
VSAT TERMINAL
FOR DATA DISTRIBUTION AND APOLLO



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the microwave group

The Company

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mitec's product line is applicable to
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- satellite earth stations
- defence systems

mitec has become a leader in the design and manufacture of subsystems. Also, in the past three years, **mitec** has taken the development of its product line one step further to include microwave networks, designed particularly for satellite earth stations, including all the necessary logic control panels.

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- Isolators

- Attenuators
- Terminations (Low & High Power)

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- International organization of 114 countries that owns and operates the INTELSAT global communications satellite system.
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- Used by many countries for domestic telecommunications.

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- 15 projects already completed or currently operational.

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- Assignees, Young Professionals, Scholar Programs provide opportunity for visiting personnel to participate in INTELSAT activities and gain valuable experience.

Special Events

- Telecommunications for Development Conference, 28 October 1986, focussed on new services and products and innovative financing arrangements. (Proceedings available on request)
- Small Earth Station Symposium and Exposition, 11-13 May 1987, focussed on new technologies, applications of small earth stations. (Proceedings available on request)

intelsat

If you wish to know more about INTELSAT, please contact your national telecommunications organization directly.

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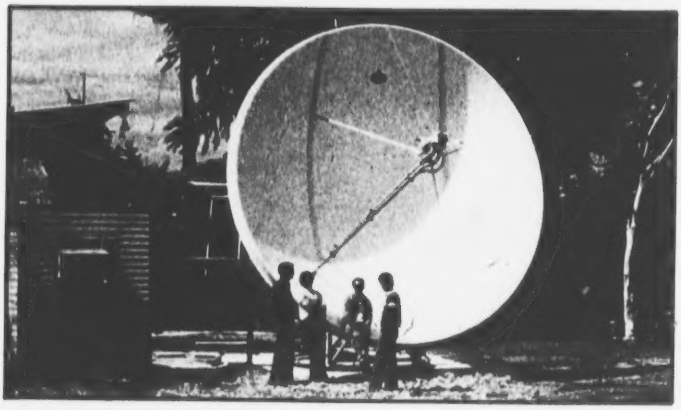
> *"The INTELSAT Agreement states that our system shall use outer space 'in the interests of all countries ... and to permit all people to have access to the global satellite system.' We remain, some two decades later, committed to that development mission through such activities as Project SHARE and the INTELSAT Assistance and Development Program (IADP)."*

Dean Burch,
Director General,
INTELSAT, 1987

Some 12 INTELSAT V and V-A satellites now form the backbone of the INTELSAT system, providing services to 170 countries and territories.

Educational applications of satellites using teleconferencing techniques are now being carried out under Project SHARE in such locations as the South Pacific, the West Indies, South America and Africa.

Training is one of INTELSAT's key development services, carried out either by Signatories directly, or through IADP and other training programs.



Small earth stations (4.5 meter in diameter) like this one are extending the INTELSAT service to remote locations for health, education and rural services.

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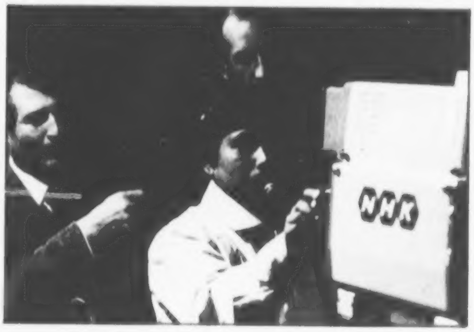
BROADCASTING

TOWARDS A GLOBAL NETWORK

by the NHK Corporate Planning Bureau

The idea of a world united by reliable broadcasting links need not seem so remote now that we possess the necessary technology. But the success of such a scheme depends entirely on international cooperation between those dealing with both the equipment and the content of broadcasting. The Corporate Planning Bureau of Nippon Hoso Kyokai, the Japan Broadcasting Corporation, describes two main areas of cooperation between nations.

THE BASIC trend of international cooperation among broadcasters can be divided into two main areas, namely the spontaneous cooperation that transcends national or continental borders, and the government-based cooperation that is directed towards the Third World in fields such as the establishment of broadcasting systems, production centres, the expansion of broadcasting networks and technological transfer achieved through the exchange of experts and trainees.



Left: *Satellite transmission worldwide has encouraged international collaboration between broadcasters.* ***Above:*** *Training is an important part of international cooperation between broadcasting organisations.*
Below: *Co-production has become increasingly attractive in order to produce high-quality programmes at affordable prices.*

Spontaneous cooperation

Broadcasting is a medium of great value in that it conveys information to people in remote regions of the world. The arrival of the 'age of television', in particular, has made it possible for information, accompanied by vision and sound, to be supplied instantly to audiences with the result that they feel that they are actually witnessing the televised events themselves.

Because of the possibilities opened up by live television, together with the increasingly international nature of society, broadcasters are now expected to be able to supply their audiences with information from a more global point of view. The advent of the communications satellites in the 1960s and the subsequent completion of a global network with three satellites in orbit (i.e. the Atlantic, Pacific and Indian Ocean satellites), further reinforced this expectation, making it essential for broadcasters to think about the management of their business in global terms.

In Japan, NHK (Nippon Hoso Kyokai), Japan's sole public broadcasting organisation, has been collaborating with commercial broadcasters in order to receive television from other parts of the world. Japanese broadcasters will never forget the impact of the first statellite transmission from the United States to Japan on the morning of November 23, 1963, using the Telstar–1 on a non-synchronous orbit, when the scene of the assassination of President Kennedy was suddenly fed into the transmitted signal. Ever since then, major news and events have been disseminated instantly, eliminating differences of time and distance, in spite of the high transmission charges the broadcasters are required to pay for the use of the communications satellites.

In the case of NHK, there were 47 satellite transmissions in one year by 1967. Ten years later, in 1976, this number had nearly quadrupled to 184. Then, in 1985, the number of ad hoc transmissions alone had reached 1,899 – 40 times the number in 1967. This does not include the daily satellite feed, the regular transmission of satellite feed received at a certain time of the day or week, which was initiated in 1976 and has now reached as many as eight feeds on weekdays.

During the 19–year history of television transmission using communications satellites, some new trends have emerged to accelerate the strengthening of collaboration among world broadcasters. When the Intelsat global system was completed in 1969, for instance, various forms of satellite transmission such as bilaterial, multiple or multilateral transmission appeared. In their turn, these encouraged an increase in the bi-directional flow of news reports and information on a worldwide basis, as well as the regular transmission of major world events such as the Apollo moon landing, the Olympics, summit talks, football championships and visits of heads of state.

As a result, and in order to overcome the high cost of satellite transmission, it has now become customary to establish a broadcasters' pool to achieve joint coverage at international level and to combine resources. In the process, international cooperation among broadcasters has improved both qualitatively and quantitatively.

The establishment of an international pool of pictures and sound makes it relatively easy to negotiate syndication, especially with the major American networks. In addition, regional broadcasting unions such as the EBU (European Broadcasting Union) and ABU (Asia-Pacific Broadcasting Union) are able to coordinate and distribute broadcasting materials among member broadcasters, thus enhancing mutual cooperation.

Indeed, the regional broadcasting organisations are already proceeding to the next step of coordinating and negotiating joint production and coverage, as well as the acquisition and sale of broadcasting rights in cooperation with other regional broadcasting unions. Negotiations are also in progress for the formation of international pools and for a reduction in the tariff for satellite transmission. Once again, this has helped to establish a closer relationship between broadcasters of different nations.

The regional broadcasting unions originally came into being before the age of satellites, when it became clear that broadcasters needed to adjust to common interests and to promote cooperation. There are now a number of such unions in existence: the CBA (Commonwealth Broadcasting Association), established in 1945; the OIRT (International Radio and Television Organisation), 1946; the EBU (European Broadcasting Union), 1950; the URTNA (African Broadcasting Union), 1961; the ABU (Asia-Pacific Broadcasting Union), 1964; the ASBU (Arab States Broadcasting Union), 1969; the OTI (Latin American Television Broadcasting Union), 1971; and the NANBA (North American Broadcasting Union), 1978.

Through one or other of these regional broadcasting unions, the broadcasters of the world voice their interests or negotiate, from either a common or individual standpoint, about matters concerning them. These may range from discussions about satellite broadcasting to the question of frequency allocation or that of setting global standards for high definition television (HDTV).

In fact, it has become increasingly necessary for broadcasters to cooperate across national borders, whether bilaterally or multilaterally, as items requiring international attention have appeared on agendas worldwide.

Since 1970, when the representatives of the broadcasting unions met for the first time in Rome, the Inter-Union Conference of Broadcasting Unions has been held regularly. The second conference was held in Rio de Janeiro (1973), the third in Tokyo (1980), the fourth in Algeria (1982) and the fifth in Prague (1986). At these meetings broadcasters discuss questions of common concern and matters that require coordination and adjustment.

The degree of integration is most highly developed within the EBU where financial resources compare favourably to the other unions and all the member countries have been interconnected by terrestrial networks since the early stages of television. Apart from news exchanges being made three times a day, the EBU has transmission circuits that are permanently leased for the exchange of programmes.

Meanwhile, within the vast area covered by the ABU, members have had to wait for the arrival of communications satellites before being able to improve daily news exchange. Indeed, the satellite tariff is still too high for the majority of ABU members.

If such collaboration among regional broadcasting unions continues, the idea of a global network could become a reality by the start of the next century, although there are still many obstacles to be overcome. In fact, an experimental television news exchange project called Global Satellite Project was put on trial for short periods in 1983 by the ABU, ASBU and URTNA. Following this experiment, Asiavision, the news exchange system which uses Intelsat satellites, was started within the ABU (see article on page 000).

Clearly, television transmission by communications satellites has brought about integration and consolidation among world broadcasters, especially among the regional unions. In addition, however, co-production has become increasingly attractive in order to meet the demand for high-budget, high-quality programmes at a time when production costs are soaring.

During 1985, NHK broadcast nine programmes that had been co-produced internationally, including 'The Louvre' and 'The Brain: A Realm Unknown'. Last year included the transmission of 'The Yellow River', a co-production with China in which ARD of West Germany, RAI of Italy and KBS of South Korea also took part, and 'The Miracle Planet', a co-production with Canada's TVO, VERONICA of the Netherlands, KCTS of the United States, South Korea's KBS and Spain's TVE. Programmes currently being planned and prepared include 'Festivals of the World', a co-production with six organisations including RTP of Portugal, and 'The World of Zen', produced with BR of West Germany and A2 of France.

There are also many instances of broadcasters from different countries cooperating under an Agreement of Cooperation made between them. As of October 1986, for example, NHK had concluded such an agreement with 29 broadcasting organisations in 22 different countries.

The kind of international cooperation discussed so far, which is maintained on the basis of the broadcasters' own judgement of its value, is really purely voluntary. It is being pursued and promoted by national and private organisations alike on their own initiative, at a range of different levels of involvement.

Official international cooperation

In contrast, there is also the kind of international cooperation being conducted on a government-to-government basis between developed and developing countries. In the case of Japan, this type of cooperation has mainly been carried out through channels of communication that run from the Ministry of Foreign Affairs, to the Japan International Cooperation Agency (JICA), the Ministry of Posts & Telecommunications and to NHK itself, since the middle of the 1960s.

Not only bilaterally, but also on a global scale, following the New International Economic Order advocated since the 1960s as a means of filling the gap between North and South, a movement aimed at establishing a New World Information Order has been promoted actively since the middle of the 1970s. This type of official international cooperation is becoming increasingly important to broadcasters throughout the world.

Among the efforts NHK has been making to promote international cooperation in the field of broadcasting, those made through collaboration with JICA are developmental research for the construction of broadcast production centres, research on the planning, equipping or expansion of broadcasting networks and facilities, the dispatch of engineering and production specialists and the training of broadcasting staff in developing countries.

The number of NHK staff on secondment to developing countries is increasing continually. During 1984, for instance, there were 29 on long-term and 78 on short-term secondments, compared with a total of only 32 in 1976.

As far as training staff from overseas broadcasting organisations is concerned, the NHK Communication Training Institute receives between 70 and 80 students a year, in association with JICA, for training courses in such subjects as educational television production and television broadcast engineering. Between 1961 and 1985, the Institute trained as many as 1,483 specialists from 81 developing nations, many of whom are currently filling essential posts in their home countries.

This type of international cooperation raises some important points. Unlike developed countries, where an abundant number of broadcasting channels are available, the limited broadcasting facilities in developing countries mean that broadcasting must play a vital role in national and social developments. In Asia, with the exception of a few countries, the television network is now well established. The next priority is therefore to develop and expand the provision of educational television. Many Asian countries, including China, Malaysia, Thailand, Singapore and the Philippines, are now doing this. Any efforts towards international cooperation should thus bear in mind the importance of educational broadcasting.

Goverment assistance for developmental research is often linked to financial aid such as grants and loans. This type of aid used to be mainly related to the supply of so-called 'hardware' or equipment, including the construction of a broadcasting centre or the expansion of an existing network. So far, financial aid for programme production itself has been limited – in the case of Japan to as little as under one per cent.

Yet, as the ultimate objective of any broadcasting organisation should be to broadcast programmes of high quality, it seems that at least 10 per cent of financial aid towards 'hardware' should be devoted to the programmes themselves. This would make international assistance far more comprehensive and thus more effective. However, the harsh fact is that even if a developing country were to be provided with the large amount of resources necessary to build a production centre equipped with a few studios, this would still not be sufficient to produce the required number of programmes to fill a daily programming schedule.

When feasibility studies are carried out in broadcasting, comparing the cost of development to the investment made, financial analysis is based on the internal rate of return. However, the figure obtained tends to be low as compared with other industries, mainly because government-run broadcasting services in Third World countries often keep audience fees down for political considerations. Even so, it should be remembered that the cultural and social value of national broadcasting of this kind is very high indeed.

This point could be made much more forcibly if a common basis of evaluation were to be devised for the economic analyses of various broadcasting projects. If an international organisation were to establish worldwide standards for estimating the value of a broadcasting network, it would be easier to highlight areas that do require some international aid.

Finally, it is clear that every nation's development is related to its historical, economic, social and cultural conditions, but that such development normally takes place against an international background. It seems certain that the international cooperation of broadcasters will help to deepen understanding and friendship among nations and thus facilitate the formation of a global society. □

N.P.
SHING LEE

COMMUNICATING INFORMATION FOR FUTURE PROSPERITY

by Dr Larry Soule

Knowledge, based on a combination of experience and new information, is vital for the healthy development of any society. But it cannot be obtained or used without an effective communications network. Dr Larry Soule, of the Rural Services Project in the Solomon Islands, describes the needs of a region whose survival is dependent upon an effective means of information exchange and explains how this could be achieved.

380

An Agricultural Information Unit has been set up to coordinate the provision of information for smallholders and farmers throughout the islands. Photo courtesy of Nigel Curtis/ORPIX.

IT IS now a truism in the industrialised world to say that development and prosperity are knowledge-based and thus dependent upon the communication and application of many different types of information. Although national policies implementing this are often more notable for words than for actions, recognition of the essential role of information and of effective communication is widespread, especially in the commercial world, and a significant proportion of investment is made in this area.

Equally, the long-term survival of people in the tropical Third World, where the larger part of the world's population lives, depends upon the application of various sorts of knowledge. The practicability of such a process depends upon an effective multi-purpose communications network: one that not only supports day-to-day administration in a country of many scattered communities, and the exchange of local commercial, weather, health and similar information, but is also capable of drawing on the enormous database of relevant information currently dispersed worldwide and converting this into a form comprehensible to a Third World audience.

Parallel to this is the capacity of a communications network to facilitate the gathering of local information, both social and especially ethno-biological, its recording and its integration into development plans. This is essential, both because local ethno-biological knowledge, often held only in oral form by ageing members of remote communities, is an important part of the world's heritage and a key to the survival of plant and animal species, and because the economic and social survival of human populations depends upon the assimilation and application of externally and internally generated knowledge.

Two additional considerations also apply. While the right hardware at whatever level generates the opportunity, the effectiveness of the communication depends on the quality of the software, which in turn depends on the personnel and the materials available. In any communications programme, at whatever level of input, at least as much attention must be given to the provision of materials production as to the installation and maintenance of the hardware. Secondly, a communications network is, of course, only a part of the equation in bringing about sustainable development. If it is to play that part effectively, the interface between it and the community requires as much attention as the hardware and software. It will affect the proportion of funds allotted to lower-level 'in the community' hardware as opposed to more sophisticated transmitting equipment and it will have a continuing effect on the content of the software.

The communications and information experience of many tropical societies tends to parallel their economic and agricultural experience; that is, a barely modified application of the methods used by industrialised, temperate climate societies to their own vulnerable cultures and more fragile tropical biosystems. This has involved the communication of ideas and information often as destructive as they were productive. The realisation is growing, in the light of painful experience, that a historically-determined dependence on a cash economy of a limited number of plantation produced mono-crops, to which most of the agricultural research education and informa-

Some 80 different dialects and languages are spoken in the Solomon Islands, an area twice the size of the United Kingdom. Photo courtesy of Nigel Curtis/ORPIX.

tion dissemination has been tied, makes a country very vulnerable to the vagaries of world market prices. This, together with a largely extractive approach to the use of natural resources, can leave a country with its cultural and ecological environment so badly damaged that increasing poverty, social destruction and political upheaval are inevitable.

In this situation the most positive aspect is the recognition of the key role of ethnobiological knowledge in enabling these societies to use a wider spectrum of their biological resources to produce a more balanced, broad-based, sustainable agriculture. A communications system would serve to enable both outside information, and the indigenous resource base, to be fully utilised. In the Third World, just as in the First World, access to information is a major determinant of prosperity, and people starved of such information will remain poor.

The Solomon Islands provide an example of both the problems and the possibilities faced by many small nations in the extension of their communications networks. In the first place, they experience the problem common to most, that virtually all development programmes have been initiated with little reference to the practical measures necessary for using the indigenous resource base represented in the many island cultures. This is probably because its potential has not yet been perceived in relation to the overriding preoccupation of government and development agencies with quick returns in cash or increased food supplies.

At the moment there is little means of capturing the disappearing ethno-biological data in written form and thus averting its loss. In a society in which between 60 per cent and 70 per cent of the rural population is illiterate, and up to 80 different dialects and languages are spoken on islands scattered over an area twice the size of the United Kingdom, it is difficult even to record this knowledge let alone to communicate it to others. It is at present held by the older generation who received it by word of mouth. Ironically, the younger generation can see no immediate use for it, although it will be essential to them if they are to be successful in applying the results of scientific research to their own problems. The population in the Solomons is expected to double in the next two decades from 300,000 to 600,000. The need for an effective communications and information exchange network is particularly pressing where there is an overwhelmingly young population with less and less access to traditional knowledge and

Participation at village level is one of the most important elements in an effective communications network. Photo courtesy of Nigel Curtis/ORPIX.

inadequate access to modern knowledge.

The tendency of existing formal education and commercially-based broadcasting systems is to sever rather than to strengthen the continuity of ethno-biological communication. The speed at which this is happening is accelerating for a number of reasons, including the fact that there is an inadequate, one-way communications network. In the absence of distance learning networks using low and medium level electronic media, education usually means children attending schools far from their own villages so that they become less intimately connected with the forest and lagoon environment. The curriculum contains virtually no written ethno-biological reference, so their future orientation is naturally towards the towns. This has in turn meant that there has been little attention paid to the damage done to fragile island eco-systems by extraction of the most easily profitable natural resources.

Awareness of the latter problem is growing, however, and with it the need for an effective communications network. Some elements of this are in place, but the disastrous fall in primary product prices has left the government so short of revenue that it has been forced to turn the broadcasting system over to a commercial basis, in turn bringing a sharp cut in the limited amount of public information broadcasting already in existence. It is a further irony of the 'information age' that the development banks and aid agencies are, in practice, reluctant to fund information and communications services, in particular materials production and broadcasting costs, which are at the cutting edge of a development programme. The reasons for this remain obscure, even though the costs involved are relatively small compared to the overall costs of development programmes.

In a region such as the Solomon Islands, an effective communications network needs to give a high priority to the programming and media capacity to transfer technical information in terms that are in keeping with local cultures. It should reach smallholder families in their own language; extend and develop rapid feed-back facilities; work with the many different institutions already in touch with rural people; and make use of the mobile cheap media that the communications revolution has produced. In short, it should provide an ethno-media chain linking local cultures to one another and to outside sources.

A number of institutions related to this are already in the process of development in the Solomon Islands. Firstly, there is a national radio broadcasting station (SIBC) in Honiara which, until recently, had a Rural Services Broadcasting Section that concentrated on public service broadcasting. SIBC also had two provincial stations and was planning a third. However, owing to very severe constraints on public finance, the government has had to cut these facilities and lay off 14 members of staff.

It must be hoped that this is a temporary measure and that finance to support the work of this team and of the provincial stations will be found. It is crucial to the effectiveness of any low-input communications network that there be opportunities for locally-based broadcasting, ideally using the major local languages as well as the national language.

Equally, in the central broadcasting component of a network, a commitment to public service broadcasting is absolutely essential. A lively and flexible team in community information broadcasting is a major priority in the development of any effective low-input communications system. In the case of SIBC it is estimated that over 90 per cent of the population listens to radio broadcasts at some time during the day. Thus the opportunity for a considerable information impact already exists. With the addition of community radio telephones to allow for a greater element of feed-back, a restored or increased level of public service broadcasting could provide the basis of an effective information exchange network.

The expenditure involved even in this sort of relatively low-input system tends to be seen as a luxury for a poor country. Certainly international funding does not give it a high priority. But one of the essential points in favour of moving information to and from communities in remote terrain by electronic media is that it is very much cheaper than using print-based facilities. It also allows for a speedier turn-around time for information exchange. In this way, the existing educational facilities, for instance, which are very expensive per capita, can be assisted and supplemented to make a much wider impact.

In the Solomon Islands there is a primary education system, and a secondary system that is able to cater for only 25 per cent of those who would like to continue their studies. Pupils return to the rural areas without an up-to-date ethno-biological grounding that would enable them to use local resources effectively for the needs of the rapidly growing rural population. Many move on to the larger villages or towns, but are not able to find further education or employment. To try to meet this need, the College of Higher Education is beginning to develop a distance learning system, with correspondence courses geared to rural needs. This is assisted, though not funded, by the South Pacific Regional University. Clearly, access to a radio based communications network is essential for its further development.

In a primarily agricultural society, agricultural information geared to smallholder needs forms an important element in the materials used in a communications network. This requires a team who can make the link with external information sources, help to gather local information and, in cooperation with public service broadcasters, distance learning and extension staff, present it in a form that reaches the rural population. In the Solomon Islands, as part of the Rural Services Project, an Agricultural Information Unit has been set up in the Ministry of Agriculture to fulfil this function. However, as is often the case in development funding, a low priority is given to materials production so that only 46 cents (Solomons) per smallholder family per year is available. This raises the important general point that although it is true that people usually value something more if they have to pay for it, in a rural society which is only partially literate or involved in a cash economy people have to be convinced of the value of the information to them, and may be ready or able to pay, say, only 20 cents for a leaflet costing a dollar to produce. Information and communications costs have therefore to be seen by planners as part of the essential infrastructure provision, even though a small element of consumer payment may usefully be included at some point.

The centrally situated information producing and broadcasting units form only part of a potential low-input communications network in the Solomons. Clearly the village based links are equally essential. These are as varied as the many different islands but several main elements can be identified. Agricultural extension services function in all the provinces and a national training institution for extension is being built on Malaita Island by the Rural Services Project. Seven rural development or farmers centres are also being built which should stimulate information dissemination and communication. They would seem to be natural centres for radio communication, with each other, as well as with the national units, for information and education in addition to purely administrative purposes. With some extra personnel and radio and recording equipment they could be important centres for gathering detailed ethno-biological information.

In order to provide an effective service at

The population in the Solomon Islands is expected to double from 300,000 to 600,000 in the next two decades. This makes it particularly crucial that young people should have access to information held by the older members of society. Photo courtesy of Nigel Curtis/ORPIX.

local community levels it would be particularly important to establish communication links in the major villages. In many respects genuine participation at village level is both the most problematic as well as the most vital aspect of a communications network. For the way in which a communications link will actually function in a rural community – whether it is seen as an instrument of power by the greedy or as a facility for the majority, or treated with enthusiasm by the active few and apathy by the many – will depend not only on the quality of the information and communication available, but also on the local social structure. Like many development activities its effectiveness will depend on the people involved. Although broadcasting materials can act as the advance attack, making the first impact upon a large audience, further effectiveness usually depends upon smaller numbers of interested people using additional materials and word-of-mouth methods.

Non-governmental organisations, often church based, are well established in the rural communities of the Solomon Islands. In providing an existing focus for activity, these could clearly play an important role in a communications network. They have recently started to establish an information exchange service to help supply their own rural networks with more relevant information.

Clearly many of the main elements necessary for a relatively low-input communications network already exist in the Solomon Islands. This is also true on the Pacific Regional level, although the end of Peacesat, the Pan-Pacific Education and Communication Experiments by Satellite programme, in 1985 has had a crippling effect. Under the umbrella of the South Pacific Commission there are several institutions designed to assist the member states with the communication, research, education and conservation necessary to their survival and development. However, at this level also, the potential for an effective communications network is seriously undermined by the minimal funding given to all aspects of communication and information materials production – an attitude to information for the Third World that appears to be general in funding institutions. It is certainly to be deplored for its effect on the small nations of the South Pacific, which cover a strategic area of the globe's surface greater than that of North and South America put together, and whose economic and social stability would seem to have a word significance disproportionate to the size of their populations. ☐

***Left and below:** Seventy-five per cent of daily programming is broadcast in the relevant local languages.*

EFFECTIVE RURAL RADIO

by Florida Kweekeh, St Jerome N Davis III and Thomas Snorton

Careful audience research and programming is important for the successful operation of a rural broadcasting service. Florida Kweekeh, St Jerome N Davis III and Thomas Snorton of the Liberian Rural Communications Network, explain how they aim to meet the needs of rural communities in Liberia.

THE PEOPLE of Liberia, and in particular its rural dwellers, are finally being reached with effective and relevant radio programmes in their own languages and on topics that address their development needs.

In the mid-1970s, the government of Liberia, in collaboration with the United States Agency for International Development (USAID), decided to identify an appropriate method of reaching the 70 per cent of Liberians who live in rural areas of the country. The existing mass media coverage was very inadequate. The National Radio Station, ELBC, does not reach the rural areas effectively at all times for technical reasons. Programming is mostly in English and the content is relatively inappropriate – limited to public service activities and advertisements – for the rural dweller. The second station, ELWA, which is privately owned, carries mostly religious programmes, some of which are transmitted in local languages. Consequently the Liberian Rural Communications Network (LRCN) came into existence.

The LRCN consists of a central production unit situated in its head office in Paynesville near Monrovia and three regional broadcasting stations. These are ELRV in north-western Liberia, ELRZ in south-eastern Liberia and ELRG, in central Liberia. Each is equipped with a 10 kW transmitter.

Content

The philosophy of programming at LRCN is based mostly on the instructional system design approach, shown in Figure 1.

In order for programming to meet the needs of its audience, 75 per cent of the network's broadcasting each day is transmitted in the relevant local language. 70 per cent of the programme content is of a development nature, particularly in the areas of agriculture and education.

Before broadcasting began, LRCN's research and evaluation unit carried out audience research and identified various communities and target groups. This data has served as a basis for programme planning.

To ensure that programming is effective, listening groups have been established in each of the coverage areas. Each group serves as part of the feedback system. There is a field assistant at each regional broadcasting station responsible for ensuring constant and systematic feedback to the production nucleus, the programme department. Programming at each regional broadcasting station meets the local needs, with the central production unit concentrating on programmes from a national perspective with input from government ministries and agencies. The latter are transmitted by way of an independent side band transmitter (ISB) from the head office to the regional broadcasting stations. Also, the national news from ELBC, which is broadcast simultaneously, is transmitted daily by the same means.

Making programming relevant to rural audiences is an expensive business. It requires staff who have been trained in radio programme production, ISB methodology and logistical support (e.g. the provision of motorcycles for producers to reach the remotest village), and staff who have sufficient personal conviction to ensure that problems are addressed.

LRCN has broadened its production and broadcasting base by involving all development ministries and agencies. Over 30 personnel from these institutions have been trained by LRCN and have qualified as radio producers. They will be producing programmes related to the services offered by their institutions.

In addition, through its community relations unit, LRCN organises workshops within agencies to make people aware of the ways in which the broadcasting service can be used.

Equipment

LRCN uses an independent side band (ISB) transmitter to send programmes originating from the central production unit to the regional stations. The use of microwave or satellite channels would be the most effective in terms of quality but the cost would be too high to LRCN. A choice between the use of conventional shortwave broadcast and independent side band transmission had to be made. While both systems depend upon multiple reflections between the ionosphere and earth as a means of propagation, the ISB has two distinct advantages:

- two independent programmes can be transmitted simultaneously; and
- the bandwidth is greater and hence the programme quality superior to that of conventional shortwave transmissions.

Programmes transmitted by the independent side band transmitter are received at the regional stations where specialised receivers are used to demodulate the transmitted signals. This type of transmission requires a more sophisticated receiver than the conventional AM receiver, and therefore the programmes are not easily received by the general public except when they are demodulated and transmitted by the 10 kW medium wave transmitters at the regional stations.

The 10 kW medium wave transmitter has a primary coverage area of approximately 50 miles radius (non-directional) and a secondary coverage of about 100 miles. However, since transmission began, signals from the regional stations have been picked up at distances over 100 miles. This is chiefly because of the skywave component of the transmitted signal which is reflected from the ionosphere. Coverage beyond 100 miles is possible particularly in the early morning and late evening. Transmission during the middle of the day is very much restricted to groundwave, and therefore limited to areas within approximately 50 miles radius.

Two-way communication is possible through single side band transceivers located at the central production unit and each of the regional stations. Programmes are not transmitted by this equipment, but it is used for routine administrative activities and advice on programming. □

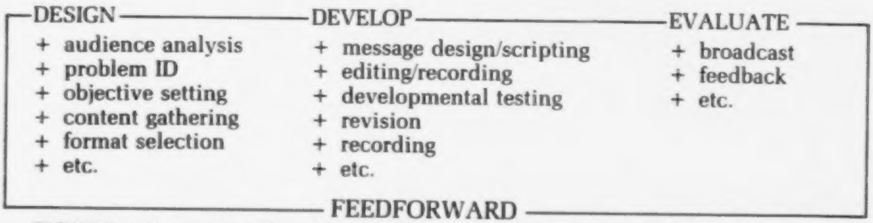


FIGURE 1: Instructional system design approach to programming used by LRCN.

EXCHANGING NEWS IN THE SOUTH

***Above:* Malaysian Television (RTM) acts as the coordinating centre for Zone-B of the Asiavision News Exchange, whose other members include BTV-Bangla Desh, RTB-Brunei, RTM-Malaysia, PTV-Pakistan, SLRC-Sri Lanka and DDI-India.**

by Tetsuo Sagara

It has long been a complaint of developing countries that their news broadcasting tends to be dominated by international newsfilm agencies and that direct news exchange between them is far too limited. Tetsuo Sagara, Senior Officer of News in the Asia-Pacific Broadcasting Union, describes the achievements of the Asiavision News Exchange in combatting this problem during its first years of operation.

ON JANUARY 16, 1987, the Asiavision News Exchange (AVN) marked its third birthday. On the same date in 1984, five television members of the Asia-Pacific Broadcasting Union (ABU) in South and South-East Asia launched a daily exchange of television news by satellite. The five members, who form what is now known as AVN Zone-B, were BTV-Bangladesh, RTB-Brunei, RTM-Malaysia, PTV-Pakistan and SLRC-Sri Lanka.

Less than four months later, on April 5, 1984, another group of news exchange was born with six ABU members participating in what is now known as AVN Zone-A, four of them in the Far East, one in South-East Asia and one in West Asia. The six, i.e. CCTV-People's Republic of China, TVRI-Indonesia, IRIB-Islamic Republic of Iran, NHK-Japan, KBS-Republic of Korea and MBC-Republic of Korea, started exchanging news material once a week by satellite.

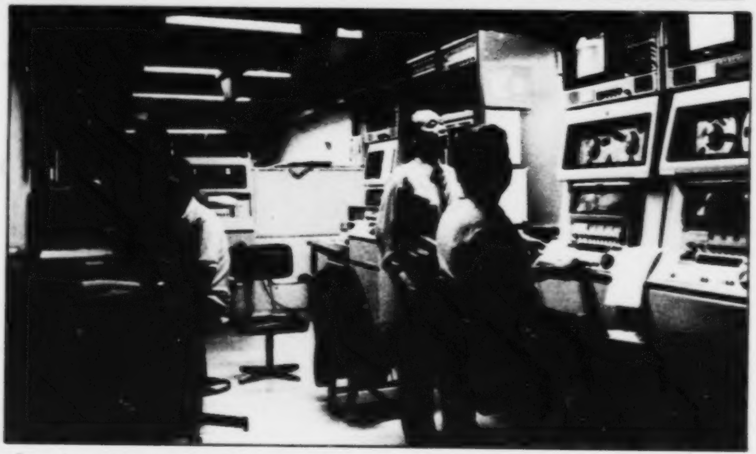
Zone-A stepped up its frequency of exchange from once to twice a week in October 1984, and again increased the frequency from twice to five times a week (daily weekday exchange) as from April 1, 1985. Late in 1984, SBSA-Australia joined the group. It had to withdraw temporarily a few months later, however, because of serious financial constraints.

On April 1, 1985, Zone-B also stepped up the frequency of exchange from once to twice a day to include more items received from Europe in its own packages. DDI-India joined the group in November 1984.

In both zones, some members take part in the exchanges to the fullest extent, whilst some others do so to a more or less limited extent for one reason or another. There are also inter-zonal exchanges between Zone-A and Zone-B as well as inter-union exchanges between each of the two AVN zones on one hand and their West European sister, Eurovision News Exchange (EVN), on the other.

Zone-A, with NHK-Japan acting as the zonal coordinating centre, chose, as explained

Right: *NHK-Japan, the coordinating centre for Zone-A, represents the only industrialised country to be a member of Asiavision.*



above, a gradual step by step approach and continues to do so, in contrast to the full-gear operation carried out from the very beginning by Zone-B with RTM-Malaysia acting as the zonal coordinating centre. Each method of approach has both advantages and disadvantages, though both zones are now considered to have successfully passed an experimental stage and are firmly established as regular news exchange mechanisms.

With the exception of NHK-Japan, all AVN participating members are in developing countries, which, during the last couple of decades, have increasingly questioned what they regard as a domination and control exercised by international – i.e. British, American or French – news and television news agencies of the north over the flow of news.

Developing countries have continually pointed out that the flow of news tended to be, by and large, from the developed north to the developing south and was almost always as seen through the eyes of northerners. Sensible journalists in the south felt it ridiculous that they had to obtain news from their neighbours not directly, but via London, New York or Paris.

They also felt that there was too much of a tendency amongst the major news disseminators to concentrate on disasters, failures and eccentric or sensational news stories rather than on the very real successes that these countries had achieved in terms of development.

AVN was conceived as a practical solution to this imbalance in the flow of news, and especially visual news, that had been a matter of much concern to the developing world. For the first time, it has enabled television organisations of Asia to exchange news directly among themselves without international agencies playing the traditional role of middlemen. It has also gone so far as to create a counter-flow of visual news from the south to the north, putting the developing southerners and developed northerners on an equal footing and enabling them to exchange news on a reciprocal basis.

There then arises a question as to what is news and what is not. Each country has its own ideas about this. In this respect, it is worth noting that, in AVN, each member is free to offer or not to offer and is free to use or not to use any news items in the packages exchanged. With this freedom of choice, it can be said that AVN has demonstrated its viability in the three years of its existence.

As for political news items, however, AVN still has a long way to go. The majority of political items offered are about the activities of a country's government, with a heavy dose of official visits. Coverage of opposition activities is rare. In some countries it is completely ruled out, as the government in the country concerned tends to ban news coverage by its national broadcaster of what is considered an undesirable event. In fact, in most

Below: *News exchanges take place regularly between Asiavision members and with their West European equivalent, Eurovision News Exchange.*

389

developing countries, including those in Asia, broadcasting organisations of a national character are a government department usually under the direct control of the Ministry of Information.

AVN members know very well that major political events are covered by private or foreign television crews and material quite often reaches the developed north, from where it can be sent back to their part of the world, usually with added commentary from the northerners' point of view. Indeed, within the limits imposed by their respective governments, most AVN members do their very best to provide other members with coverage sometimes not even shown on their own domestic networks.

When it comes to economic development news, however, the situation becomes slightly different. Although one of AVN's main purposes is to exchange news stories of this category, the reality is far from the ideal. Every AVN member is eager and ready to offer economic development news items, but other members are not so keen to use them. The dilemma has yet to be solved.

With regard to the possibility of further expanding AVN participation, while most, if not all, ABU members have indicated interest in joining AVN, some have been unable to do so because of the high satellite tariffs prevailing in the region. Ironically, telecommunication tariffs, including satellite tariffs, are an important element of government revenues in many developing countries, thereby making it difficult for governments to look favourably on requests for satellite tariff reductions. On the other hand, those same governments have made it clear that they want a more balanced flow of news and information.

There have been many attempts to break the deadlock, one being the planned introduction of a multiple-origin/multiple-destination satellite service.

AVN members have no alternative but to rely entirely on satellites for their news exchange, as there is no country-to-country terrestrial telecommunications link in the region. However, under the present system of a single-origin/multiple-destination service, together with its 10-minute minimum and 10-minute switching time, a considerable amount of satellite time is being wasted, especially as AVN members usually use a maximum of five minutes for each of their contributions. This totals approximately 45 minutes of unused space segment every fully-operational day. To this, the 10-minute switching time adds at least 90 minutes of unused intervals.

From a financial point of view, the current system means that each AVN member must pay the 10-minute minimum charge for each contribution, regardless of how many minutes the station has actually used. Over the year, this imposes an enormous financial burden on most of the members in developing countries. From a journalistic point of view, members often have to start quite early in the day, without being able to cover the day's major events.

The proposed multiple-origin/multiple-destination satellite service will certainly eliminate these headaches to a large extent. Under the new system, the satellite circuits will be switched almost instantaneously from one uplink to another. In other words, immediately after the contribution from one member is completed, the contribution from another member will start. No intermediate recording, editing or playback will be necessary, as each contribution will be received and recorded by all other members directly and simultaneously.

This will certainly result not only in saving facilities and manpower but also in preserving the technical quality of material and in eliminating the current loss of at least one news cycle at the coordinating centre of each zone. Also, by pushing the contribution deadlines from morning or noon to afternoon, the chances of including same-day material will increase.

All in all, the advantages of the proposed new system are obvious. Intelsat signatories are now studying the idea, while AVN members are preparing for a trial run.

Despite all sorts of problems, the achievements of AVN and its contribution, in particular, to the enrichment of the news programmes of the participants, have strengthened their commitment to the project. Reports from AVN members indicate that the service has helped to create a greater knowledge and understanding of neighbouring countries among audiences, and that AVN news items have helped to change the stereotype image of neighbouring nations prevalent in the past. The vast range of items exchanged and telecast has enabled viewers in developing countries to realise that they have neighbours and to see these neighbours as they really are – beneath the usual headlines of riots and disasters.

Now in its fourth year, AVN is no longer in his infancy. It has crossed the point of no return. And its members strongly expect that, in the near future, a global news exchange – could we call it 'Mondovision'? – will become a reality, with the participation of broadcasters from northern and southern hemispheres. □

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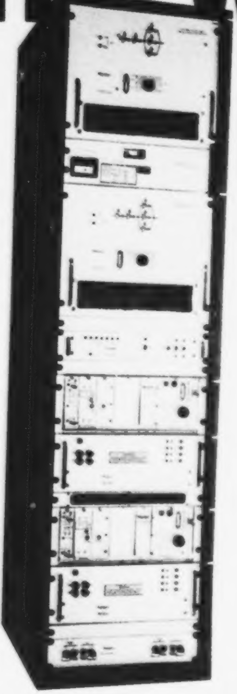

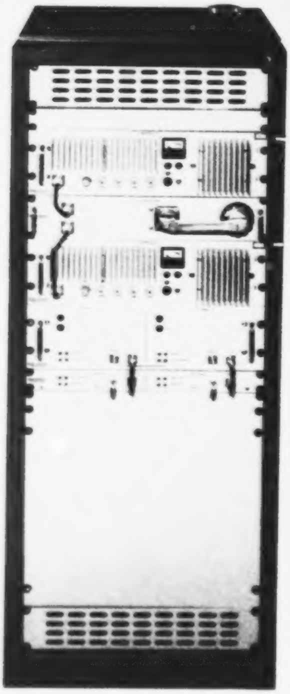

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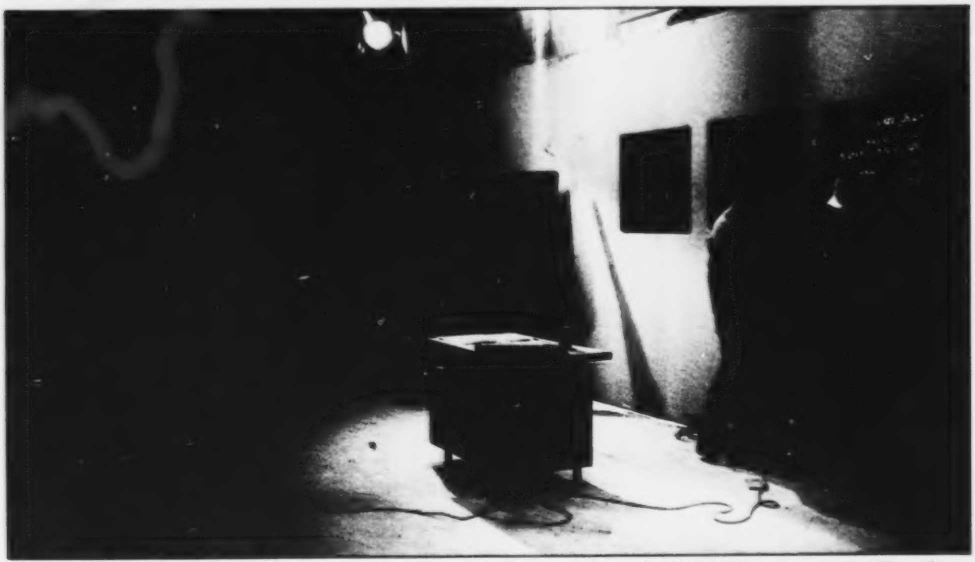


Above: *Technical quality is a vital consideration in effective educational broadcasting, especially when programmes are designed for repetitive replay by students. Photo courtesy of UNESCO.* ***Below:*** *Clear objectives at the planning stage are essential in order to make the best use of television as an educational tool. Photo courtesy of UNESCO.*

LEARNING BY SATELLITE AND CABLE

by Jim Stevenson

Television has long been used for educational purposes but its potential is far greater, especially for developing countries, now that satellite and cable communications are available. New technology has made it possible to reach a student at the farthest corner of the globe. Jim Stevenson, Head of Educational Broadcasting Services and Education Secretary of the British Broadcasting Corporation, suggests how educational broadcasting can make the most of these new opportunities.

THE traditional teaching/learning environment of a university campus is an excellent place for the acquisition of knowledge, skills and for intellectual development. Professional people in the developed north have, at one time or another, been through such an environment. But for the most people in the world, particularly in the developing world, this remains an unobtainable luxury. One can be critical of medical schools and universities but it is a sophisticated criticism based on assumptions of high excellence. It is generally recognised that universities in the developed north and west are good places to be and, as such, they might be regarded as a norm – a basis on which to build concepts of learning at a distance.

The student in a first-class university or teaching hospital is bombarded with inputs which he or she uses almost unconsciously. Whether these are from books, lectures, patients, operating theatres, laboratories or coffee bars, the result is one of total immersion. Such learning environments could truly be said to be multi-media.

At the opposite extreme is a student studying alone at a distance from his or her tutors. Such distance learning situations are increasing, not only because of economic and educational necessity, but because such systems can work. Even so, the richness and the media are limited. The term 'multi media' is often used to describe a mixture of correspondence tuition and broadcasting when what is really meant is 'limited multi-media', often severely limited to tri-media and bi-media.

Much academic time has been devoted to analysing and comparing each medium in these learning situations. It is rather like comparing ham and eggs with apple pie – they taste different but they both reach the same destination. It is also unfair to compare one medium, say television, against another, say print, when the total teaching package is 90 per cent print and 10 per cent television. All we can really do is draw up a few broad guidelines.

Television, or any medium, does not lend itself instantly to education or entertainment. Often it seems to do the reverse. A camera pointed at an event records only a fragment of the reality. The campus lecture recorded on television as a straight lecture is less fun to watch than a live performance. War, sport, music and education are all diminished by television. So why do people think it is a powerful teaching tool? It can be, but it has to be used well in order for it to be effective.

In higher education, particularly in the sciences and medicine, television has five major advantages.

Firstly, it can take us to places beyond our own limited environment. We are all now familiar with the Arctic, the jungles, the deserts and their inhabitants. We have all been, at least we feel we have been, to the depths of the oceans and to outer space. We have even explored the close-up world of biology and medicine.

Secondly, television can bring us close to the giants in our field. We can see philosophers, doctors, painters almost in the flesh talking to us. It is the very intensity of such programmes which enhances our impressions of such people. What they tell us remains with us for it is a privilege to see them and to listen to them.

Thirdly, television can show us experiments and demonstrations which would be expensive, dangerous or just impossible to do in the classroom.

Fourthly, through the technologies of animation and visual effects, concepts can be explained in a way which would be quite difficult to achieve in the classroom.

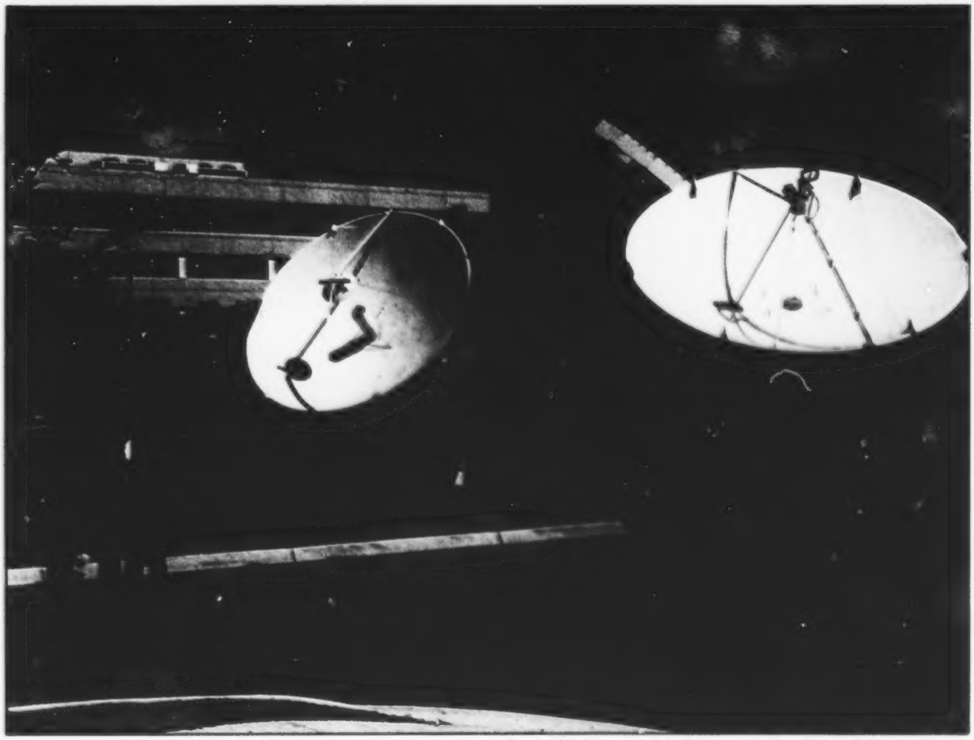
And finally, television can teach specific skills. How to mend your motorcycle, how to look after your plants or dogs, how to deliver a baby, how to fill teeth. The camera can go into places where the eye, or at least the classes' eyes, can hardly reach, releasing the teacher from the constraints of the bench.

Television does present one big problem for the serious learner, however. It is ephemeral and, in the main, programmes have tended to be seen only once by the student. By contrast, books can be re-read and learnt, practical work can be discussed and re-worked for hours. But until relatively recently broadcasts arrived instantly and were gone in minutes, leaving only an impression. Home recording and the banking of recordings in schools and universities has, of course, changed this ephemerality to a degree. But programmes are still, on the whole, made for one viewing only with a beginning, middle and an end. They tell a story at a pace which people can enjoy. Formats specifically designed for repetitive replay and extended in-depth learning have not, so far, been tried and tested.

If video or audio material is to be created specifically for repetitive replay, the nature of the product itself will change. It may be more like a text book than a novel. Perhaps it will be in small segments, or require other parallel activities. Perhaps, in the case of television, it will have more emphasis on pictures than on words. Perhaps it will be what the historians call primary source material. There are many routes to follow and this is a major challenge for those who would develop distance learning systems, particularly at the professional level.

Whichever programme format is chosen, however, there are two major areas of concern which need to be addressed constantly.

First, technical quality. It would be foolish to make the assumption that because an audience is committed to learning a subject, it is likely to tolerate shoddy material. The audience which watches educational television is the same one which watches drama, light entertainment, news and sport on the same screen. It expects the picture to be in focus and properly lit. On radio it expects high-quality sound, often in stereo. It expects not to be jarred by discontinuity. Scenes must be edited to provide the same smooth effect as with any other good programme.



The uplink array for the medical teleconference from the Miami Children's Hospital in Florida, a multi-national, multi-satellite project linking North, Central and South America and Europe, organised under the auspices of Project SHARE.

The question of technical quality is even more important when the material is designed for repetitive replay by a student. On second, third and even fourth viewing, pictures and words receive considerable scrutiny. Mistakes will become obvious, if not annoying. Ideally, the material should be of such depth that the student will get more out of it with each replay not less. Poorly assembled material can, under scrutiny, become educationally counter-productive.

The second area of concern is the cost involved. Television is a labour-intensive industry using people with many skills. There are cameramen, sound recordists, designers, model makers, editors, lighting engineers, producers, administrators and, most expensive of all, academics and other performers hired by the hour.

Even so, the use of broadcasting for distance learning clearly has its advantages and, as with the brilliant lecturer in the classroom, its moments of pure delight.

What, then, does the student require of audio and video from which he or she is expecting to learn? It almost goes without saying that objectives have to be set, and yet too often a broadcast is made without this consideration. The reason for making a particular programme has to be established at the outset. Would a written piece be just as good or better? Would some television work better on radio? An educational television programme can sometimes be better understood with one's eyes closed. Similarly, much educational radio cries out for pictures.

It is also important to preserve open-endedness in some programmes to make them interpretable by different people at different levels. A complex piece of science can create a sense of wonder in a non-specialist and at the same time be valuable detail to a scholar. If a broadcast can be regarded as 'source material' it has a greater chance of being used flexibly and preserved longer than if it is merely a second-hand interpretation.

Modern technology has certain implications which can have a direct effect on educational broadcasting. In particular 'interactive learning' and the opportunities offered by satellite communications must be considered.

Interactive learning in relation to new technology has developed only recently, with the advent of the videocassette and the home computer. But what is interaction? Some people would maintain that if a student switches off his or her cassette for a moment of thought and switches it on again, he or she is interacting with it. This is clearly nonsense. It is as impossible to interact with a cassette, or even a computer, as it is with a motor car. Machines do what you tell them to do. They do not interact with you. Interaction in education can only be between people.

Teachers and students interact, often disastrously. Students interact with each other, often very enjoyably. To conduct such interaction at a distance is hard. And for those who work in educational broadcasting, communication has almost always been one way. There has, of course, been feedback – broadcasters talk to the audience, receive advice, develop joint policies with the users of education. But the broadcasts themselves have simply been delivered. Communication by satellite and cable is beginning to explore a change in that.

Under Project SHARE (Satellites for Health and Rural Education), a programme run by Intelsat in conjunction with the International Institute of Communications (see page 324), a number of satellite links have been established between widely separated institutes. For example, the Higher Education for Development Cooperation Organisation in Ireland has mounted a series of lectures on the subject of water resources and delivered these live by satellite to the University of Amman in Jordan. After each lecture Jordan used an audio link to ask questions of the lecturer or expert panel. The link was established by terrestrial line from Ireland to the United Kingdom and then via satellite from the United Kingdom to Jordan.

Under another distance learning system developed by Charing Cross and Westminster medical schools in London, presentations are given live each day to students in six teaching hospitals elsewhere in the capital. Interactivity is preserved and the bond between clinical practice and medical theory is strengthened, while the students and teachers are released from the time-consuming business of travel.

Another SHARE example is the ambitious multi-national, multi-satellite project run by the Miami Children's Hospital in Florida. Literally thousands of physicians in countries throughout South and Central America with links to Spain have been involved in live seminars. Each presentation was followed by questions – more so, in fact, than might have been expected had the audience all been in one room.

A comparison between this type of interactive television and broadcasting is really irrelevant. This is pure point-to-point interaction, a genuine live exchange between people at a distance. It is more like conversation than television. What has characterised the presentations from Miami and also the daily presentations in the teaching hospitals in London has been the mixture of recorded video or film professionally knitted into live presentations with questions.

Another benefit of both satellite and cable is that they avoid the constraints of crowded airwaves which are restricting traditional broadcasting methods, especially in industrialised countries. Suddenly hundreds of channels are available. For satellite delivery, the only problem for broadcasters is to persuade people to buy the receiving antennae and governments to allow individual or at least institutional reception. The problem for a cable system is to lay the cable network.

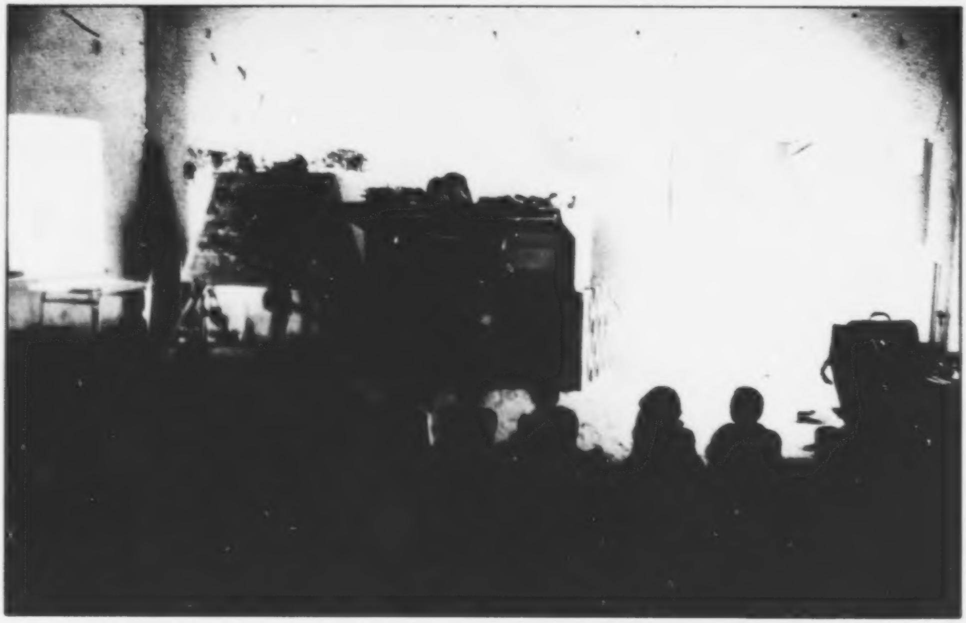
Perhaps the most important point to emerge from Project SHARE and similar developments is that, through satellite and cable technology, individuals and organisations can now communicate using television in ways which were previously only available to more powerful interest groups. There is now a growing awareness of the potential for uniting scholars, health practitioners and educationalists in this way.

They also illustrate the possibilities for two-way communication rather than one-way – a feature which should be fostered and developed. Traditionally, educational television and radio have been one-way only, and it would be a pity if the accent of the developing satellite and cable systems were to be primarily one of delivery rather than exchange.

Thirdly, satellites, in particular, can facilitate communication over vast distances and difficult terrain in a way which is often impossible for terrestrial broadcasting.

Interactive learning through educational television and radio looks set to expand as we approach the 1990s. Satellites will probably be the key to this but cable systems also carry much potential. Many people will learn through the development of these media and, as they learn, the media themselves will develop.

The challenge for educational broadcasters is to extend their knowledge of the techniques and technology of communication into those areas of the world which desperately need education for their own development and survival. The technology is almost there. The problem is finding the best ways in which to use it. □



DEVELOPMENTS IN DISTANCE LEARNING

by David Worlock

The opportunities for sending educational packages to meet the needs of audiences in remote locations are becoming ever greater. If used imaginatively, long-distance teaching aids can both support and extend existing educational structures, as well as taking information to entirely new destinations. David Worlock, a director of Electronic Publishing Services Ltd, is Chairman of the UK Confederation of Information Communication Industries (CICI) Market Development Group which has recently set up a Distance Learning Forum. Here he outlines some advances in distance learning techniques that could be of particular value to developing countries.

EVER since Gutenberg's moving type enabled mankind to package knowledge in easily portable parcels, learning from a distance has figured high on the agenda of uses for information communication. While textbooks came to be seen as teaching aids in situations where teacher and pupil faced each other regularly, correspondence courses and programmed learning packages have a long history of helping the remotely-sited student to self-enlightenment. From them have sprung a whole generation of distance learning styles and media in the 20th century, offering 'open' learning opportunities that at times exceed in potential the resources of the classroom-based student.

Chief amongst the characteristics of these new developments in distance learning is a multi-media approach. This combines features of a range of technologies selected for their ability at handling certain types of teaching material, and the capability to re-use instructional information at a variety of levels by

Above: *At its most basic, distance learning can revolutionise the quality of education where both human and financial resources are lacking. Photo courtesy of UNESCO.*

Right: *A student participating in a tele-education project in Indonesia using computer conferencing: new technology has transformed the range of possible distance learning methods. Photo courtesy of Intelsat.*

including it in different modular structures. It is also true to say that while all distance learning packages share the fact that face-to-face teaching is seldom, if ever, employed, they vary immensely in other ways: for example in the amount of interaction which takes place between the student and the system, the amount of evaluation which takes place through the system and the amount of networked resource available to the student to support educational systems with inadequate local reference materials.

Multi-media approaches to distance learning involve a wide range of currently available technologies. Simply listing them illustrates the richness and variety of instructional styles available:

☐ audio and video, as broadcast radio and television, cable systems, or direct broadcast by satellite, or as portable tape or cassette;
☐ data communication, either carried by packet switched networks or by radio and bandwidth communication;
☐ software, either as a stored product sold on floppy disc or broadcast or communicated via a data network;
☐ print, as books, journals and texts, including tests and evaluation materials sent by post;
☐ optical storage, utilising compact disc – read only memory (CD-ROM) (or, in the future, compact disc – interactive (CD-I)) to create local storage facilities for major reference resources or interpreted learning experiences (as with the BBC *Doomsday Book* project) on video disc.

Major participants in the distance learning development field, like the UK's Open University, have been recombining the source media since the 1960s. Video, audio and print resources are now increasingly harmonised in teaching packages with data and software. Future distance learning specifications may place more stress on the availability of a micro computer and modem (or supply them as courseware) than upon domestic television receivers or audio cassette players.

The choice implied by this listing indicates that the only educational experience which cannot be replicated within a distance learning package is a face-to-face interaction with a teacher. Direct interaction, either by store and forward messaging through an electronic mail network or via direct data network interaction (the distance learning equivalent of real time trading) has some of the same factors, though the loss of warmth and personality in the exchange is not always compensated for by a more ordered and structured dialogue. Even teleconferencing does not entirely satisfy this requirement, and interactive video, widely used in distance learning, has similar drawbacks.

If the range of possible options offers seemingly endless permutations of content, style and media, then the levels and types of application match them. While distance learning was originally envisaged by many educators as surrogate classroom education, the application of advanced communications media, and in particular the prospect of the use of direct broadcasting by satellite (DBS), extends the range very considerably. A checklist of potential applications submitted recently to the international funding agencies in the field included, in terms of the less industrialised world, the use of satellite communications (along the lines proposed by consultancy reports on the European Space Agency's Olympus Project) to manage:

☐ the enhancement of classroom-based education between the ages of 7 and 18, with profound effects upon the management of existing teacher resources in areas where human resources are severely stretched, class numbers are high (pupil:teacher ratios beyond 30:1) and local support resource (textbooks, libraries, advisory teachers, etc.) are not great;
☐ the development of patterns of technical

and vocational education which can be superimposed upon existing systems. The United Kingdom, in the development of the Manpower Services Commission's distance learning applications the growth of the Open Tech and the establishment at the Open College, has indicated ways in which a mature education system may need this support. Identical requirements are identified in societies where the educational infrastructure has simply not developed sufficiently to react to this type of skills shortage.

☐ the use of distance learning to supply and extend university education. If the experience of the Open University in Britain offers a guideline, then this will be a mixed function. Providing a 'second choice' programme for primary degree courses may not in fact become the predominant pattern of activity. Diplomas, short courses and the entire field of supplementing 'after hours' learning for professionally-qualified individuals, often teachers themselves, are part of a demand curve that matches the original programming in scale. This may be a particularly important trend in countries where enhancement of the skills of this small but vital sector of the population has profound development effects on the society as a whole.

☐ the growth of major management education initiatives. Current distance learning activities range from formal qualifications (Henley, The Management College, was a leader in what became in the United Kingdom the notion of an 'Open Business School' offering MBA courses) through to management education and retraining 'on-site': major corporations (British examples would include British Gas and the British Steel Corporation) employ the availability of distance learning via advanced communications networks to upgrade skills on a variety of remote sites simultaneously via centrally controlled programming.

Each of these styles of activity is being applied to some extent in less or non-industrialised societies. Facilitating factors have included the ability of optical storage devices combined with long-range communications systems to site major reference resources locally and upgrade them either via data transmission on the public switched telephone network (PSTN) or through DBS. For instance, local storage of reference resource features in the development work of the national and international atomic energy authorities, using CD-ROM to create major 'library' facilities for use in environments where the telecommunications network may be inadequate or unreliable. The ability to effect satellite data transmission to such remote centres becomes a vital factor in local staff development and support, and not only in a 'disaster' scenario.

The most coordinated attempt to impose a pattern on these distance learning developments has been made by the European Commission in its DELTA programme. Announced in 1986, DELTA (Development of European Learning by Technological Advance) combines computer-based retraining, advanced communications and the so-called 'fifth-generation' technology in a three-phase plan. Phase I envisages the application of the current technologies, including the use of education channels on licensed DBS, much as described in this article. The second phase, operational in the early 1990s, foresees the application of integrated services digital network (ISDN), widespread satellite distribution, high definition television (vital for certain types of scientific programming) and the use of expert systems which run beyond the current development of rule-based systems. The third phase, in the mid-1990s, moves beyond this point to the creation of knowledge-based learning systems. Broadband communications will be fully deployed at this stage, with 'fifth generation' technology playing a vital role.

The DELTA workplan includes the creation of a test-bed to establish 'a set of communications, components and related management services to support the testing of new learning technologies and pedagogical concepts under the DELTA programme'. This development, called SOFT (Satellite-based Open Facility for Testing) proposes the establishment of SOFT-NET (an advanced communication network, linked to EARN, the European Academic Research Network); the implementation of SOFT-CHANNEL, a general educational satellite service linked to data dissemination via Teletext and low speed audio and data feedback via the PSTN; and the design of SOFT-LINK, a special high capacity satellite service using teleconferencing, video dissemination and large volume data distribution for specialised educational services, particularly in the business and professional environments outlined above.

The variety of these approaches indicates the importance of using the available communications technologies flexibly in order to cater for learning market demands, rather than seeking to impose standard forms of educational transfer. The EEC's DELTA initiative will be closely observed for the lessons it provides for less industrialised nations. ☐

A trainee from Tanzania presenting a news programme during a practical course. Students are expected to work under the same sort of pressure as the BBC's own staff.

CULTURAL UNITY THROUGH BROADCASTING SKILLS

by John Turtle

Learning to work under pressure is as relevant to a broadcaster from a remote station in India as it is to a producer with every modern technical convenience. Realistic practical training, under the supervision of experienced professionals, is the most effective way of acquiring broadcasting skills. John Turtle, Head of the Radio Training Department at the British Broadcasting Corporation, explains the philosophy behind today's training courses.

FIFTY years ago the BBC welcomed the first two producers from a developing country to join a course at the Staff Training School. In 1937 the course lasted three months and covered engineering, programme administration and television as well as radio broadcasting. The first high definition television service in the world had started the previous year from the BBC's Alexandra Palace studios in North London, short wave broadcasting from London to the British Empire was well established and the need for systematic staff training had become acute.

Surprisingly large resources were put into the school, including a modern drama studio. The teaching staff was headed by a senior and respected executive, Gerald Beadle, as Director of Staff Training, with the experienced and innovative producer, Archie Harding, as Chief Instructor. Teaching methods were very much of the era: a few practical exercises, and lecture after lecture by the BBC's own senior staff and experts, followed, in the case of the two producers from India, by a grand tour of BBC regions. The pace of training was slow, and many bright talents on those early courses had to learn, and make many of their mistakes, on the job rather than in training. Some had no formal training at all.

After the Second World War, when British industry as well as the armed forces learned a great deal about effective training methods,

A producer from Mozambique at the microphone. Often the acquisition of broadcasting skills helps to overcome any cultural differences between broadcasters.

there was a greater emphasis on practical work, better training studios and equipment, and shorter and more intensive courses. There was also a determined effort to treat adults as fellow professionals rather than students, and to change the setting and atmosphere as well as the title of the school.

From the mid-1950s onwards there was an upsurge in trainees from outside Britain, as British colonies moved towards independence and their own broadcasting organisations. BBC staff, sometimes seconded for a number of years, helped to train new producers, engineers and managers in the radio stations of Africa, the Far East and elsewhere. Meanwhile the then Staff Training Department took at least 36 people a year on special courses in London as well as mounting courses in their own countries.

After this peak period of training, some larger organisations set up their own staff training at the BBC in London as well as asking for help on station. In recent years funding for such courses through British technical cooperation has been scarce, with pressure from competing needs in developing countries, and other funding bodies have been unable to fill the gap. Now only about a third to a half of the number of ten years ago can get to London, and the funds available for on-station training visits are subject to the same pressure.

Help which the BBC can offer has to be economical yet effective, thorough but brisk, and directed towards enabling organisations overseas to train their own staff without relying on Western experts. Every year two courses for potential radio trainers are offered, leading to the examination for the BBC On-station Instructor's Certificate. Recently a series of two- and three-month courses for radio managers have been run, with teaching shared between senior staff of the BBC and the Management Studies Department of the Polytechnic of Central London. The latter specialises in postgraduate teaching of managers including large numbers from developing countries.

The Overseas Radio Production Course of two months, with an optional third month of specialisation, is now only offered twice a year, starting in April and September. One recent innovation is a third month specialisation in drama for development, with an emphasis on scripted and improvised drama designed to change attitudes and impart information on health, farming and other subjects while at the same time entertaining the listener.

All of these courses involve the challenge of relevance. What can the training staff of the largest broadcasting organisation in the world, working in one of the great capital cities in a developed country, offer to a hard-pressed producer or manager from a developing country? If we take the definition of training to be distilled experience, one answer must be the opportunity to learn from 60 years of success and mistakes made within the BBC, and to observe one alternative way, at least, of addressing the day to day problems that beset every broadcaster. Many of the BBC training staff have experience in developing countries. All are professionals with substantial records of achievement rather than academic theorists. There are training studios in London specially designed for sustained practical exercises and, where necessary, trainers working on station can take equipment with them to reinforce local resources.

Most important, though, is the learning that takes place through sharing experience with broadcasters from other countries in an atmosphere where experiment and personal responsibility are encouraged and individual talents developed under the tutorship of trained instructors. Adults learn best when confronting realistic problems, and it is now a key part of BBC Radio Training philosophy that trainees are expected to work hard and fast under the same sort of pressure as their colleagues on the BBC's own staff.

This can come as a shock to the occasional trainee expecting something more relaxed. They must react to the red light switched on at the precise second for transmission – no sooner, no later – and the need to be there with script prepared, interviews and actuality recorded and edited, in good heart and voice day after day. Nothing is acceptable that does not reflect the trainees' true potential and the needs of their organisation and country. Nothing is more rewarding than helping them to achieve it.

There is a relevance, too, in the common core of skills, knowledge and judgement which makes up the professional tool-kit of radio broadcasters worldwide. Using portable recorders, acoustics in the studio, sound effects, editing tape, broadcasting quality, newswriting and more general scriptwriting, the special requirements of programmes designed to teach or help with a curriculum and the best ways of presenting information for the listener are just a few of these. Social and political constraints, language and the level of literacy and development in a country matter less in training than the opportunity to master the medium, to make sound tell a compelling story, to transmit information and to unite listeners in a common understanding of events, facts, their own culture and those of others. Indeed this international common core tends to unite radio professionals, more than their national, cultural and religious differences set them apart.

In order to be effective, practical exercises must be held under realistic conditions. Accordingly, live programmes are broadcast on closed circuit around the Radio Training department. For managers there is a substantial body of knowledge and teaching experience based on the problems of pulic service, industry and commerce. To this had been added a growing number of case studies designed to give a trainee manager that sinking feeling of despair: a problem with no obvious simple solution but rather one that demands indentifying, applying and then defending the lesser of many evils. The debate is stimulating for the instructors as well as trainees, and from their joint experience come yet more demanding case studies.

The speed at which adults learn when given a stimulating environment to work in, together with expert tuition, is astounding. In an experimental course of adult educationists working in developing countries held in the late 1970s, Bennett Maxwell, Bob Salkeld and Graham Tayar discovered that a group with no previous experience of broadcasting other than as listeners could progress to being competent enough to do interviews with a portable recorder, edit tape, write scripts for talks and links for a basic magazine programme to an acceptable broadcast standard with five working days. This was with no formal lectures or any major instruction other than demonstration.

The greater part of teaching takes place during the playback and review of the trainees' own programmes, where their handling of other members of the team and technicians is a matter for critical analysis as well as their editorial and technical expertise. The method also demands that each trainee comments on the work of others, developing analytical skills coupled with an ability to offer constructive criticism directly to a colleague. Whatever the cultural traditions, experience has shown that the method works as well with trainees from overseas as with British members of BBC staff. It has the advantage, too, that trainees are not distracted by trying to ape recorded examples of 'good' work played to them during a lecture. Instead they are judged on their own work and progress in the context of their own capabilities.

Training provides an environment in which mistakes can be made without the risk of any damage being done to a broadcasting operation. It is an investment which has immediate benefits and one which will gain in value as the best training practices are passed on and developed still further. There has never been a time where systematic training needs to be taken more seriously. □

TRAINED BROADCASTERS – A VITAL RESOURCE

by Dr Peter Holasek

Editorial and technical expertise is an essential component for the successful operation and expansion of any broadcasting network. Dr Peter Holasek, of the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH, explains how training projects supported by his organisation are meeting broadcasting needs in Africa.

ON BEHALF of the Government of the Federal Republic of Germany, the Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) GmbH in Eschborn, near Frankfurt, is currently implementing more than 2,000 projects in 105 countries, together with its partners in those countries. Out of these there are almost 40 ongoing promotion programmes of varying scope in the broadcasting sector. In addition to expanding the technical efficiency of the partner organisations by developing the media infrastructure (e.g. transmitting stations and studios), each project focuses on advisory services and the upgrading of the local specialists on site.

Depending on the problems to be tackled, the main fields of work are:

☐ organisation, management and planning;
☐ programme editing and production; and
☐ broadcast engineering.

In most cases, 'know-how transfer' takes place through the joint development of solutions to problems, through practising certain work routines and through the direct transfer of skills in operating and maintaining equipment at the actual place of work, i.e. 'on-the-job' training. This method is supplemented by courses and seminars in which basic elements of theory are explained.

Many stations in developing countries are unable to establish their own training/upgrading facilities for broadcasting specialists for purely financial reasons. Training is only economically viable when the number of participants is very large (as in the case of Cameroon), or specialisation requires that it be carried out at regional level (as in the Centre for Rural Broadcasting Training in Burkina Faso).

Cameroon is one of the few countries in Africa whose economic development has steadily progressed. A long time elapsed before the decision was made to introduce television, but now a nationwide and ultra-modern production and transmission system is being launched, with the new installations due to become fully operational by the end of 1987. When the project commenced in 1985 there were practically no Cameroonian specialists in this field. German-Cameroonian cooperation in this project aims to upgrade the capabilities of appropriate personnel in the areas of editing, production, studio engineering operations and maintenance engineering. In addition to the organisational, technical and planning activities involved in creating a training institute, all activities focus on conducting the following training courses:

☐ a two-year programme for 120 operations and maintenance engineers (vision/sound and cameramen), corresponding to Niveau (Level) B of the Cameroonian Fonction Publique (civil service);
☐ a two-year programme for 13 directors and editors (Niveau A);
☐ a one-year programme for 13 assistant producers and directors (Niveau B);
☐ a six-month programme for 33 presenters, announcers and assistant editors.

Firstly, functional curricula were drawn up for the long-term courses, together with the Cameroonian specialists. This enabled teaching and learning material requirements, and also supplementary equipment necessary for technical and production-related instruction, to be identified.

The Cameroonian teaching staff then underwent special training. The technical subjects are based on standardised concepts which have already been tested throughout the world, but which must be adapted to the specific requirements of television operations.

Practical experience plays the most important role in the training/upgrading procedure. In the form of production teams, editors, directors, cameramen, production staff and operations engineers prepare broadcasts and thereby learn the need for teamwork and the complexity of dealing with the medium. Maintenance engineers receive practical training through measurement exercises, fault location and rectification, handling special tools and appliances, etc. The prospective editorial staff and directors all take a course of studies in journalism at the University of Yaoundé (ESSTI).

Training courses are also conducted in the Federal Republic of Germany for particularly highly-qualified staff or prospective teachers, and in specialist fields in which upgrading in Cameroon would not be practically possible or economically viable.

Obviously the ongoing courses – the first of their kind in Cameroon – still have to be adapted to a large extent to the specific knowledge and experience of the students. The same applies to the internal organisational routines and structures of the training institute. In addition to the long-term programmes, short courses, seminars and individual lectures are also held in increasing numbers. And, in future, the training institute will take on all in-service and refresher training of television employees.

In contrast, the Centre Interafricain d'Etudes en Radio Rurale/Centre for Rural Broadcasting Training (CIERRO) in Ouagadougou, Burkina Faso, concentrates on training personnel for regional broadcasting networks.

A new trend in the programme structures of African broadcasting organisations and their supervising political authorities has emerged over the last 10 years. 'Rural areas' are increasingly recognised as a potential mobilising force, and broadcasting is preparing to extend its services – previously oriented primarily towards the urban elites – to a rural listenership. Instead of the previous diet of well-meaning 'farmers' programmes', the rural audience is now offered a comprehensive range of programmes with all integral components – information, entertainment, education, culture, etc.

An expansion in this kind of service depends to a great extent on the availability of qualified, highly-motivated editorial and technical staff. It should be borne in mind that a dwindling number of appropriate programme contributions originate in the studios of the capital city, for instance. Instead they are produced through recording tours with the direct participation of listeners in the regions, many of which are remote.

The broadcasting stations, however, lack the specialists needed to carry out these tasks. Such specialists must firstly be fully professional in radio production and, secondly, be familiar with the cultural, economic and psychological conditions of working with the media in the mostly traditionally-structured rural areas. Previously there were virtually no possibilities for polyvalent, integrated specialist training in these activities, apart from a few courses offered by the Deutsche Welle, Cologne. The problems of upgrading courses in rural broadcasting outside Africa are obvious, however – all practical relevance to the target group is lost.

CIERRO, which was founded in 1978 by the African Broadcasting Union (Union des Radiodiffusions et Télévisions Nationales d'Afrique), offers editors and technicians from francophone broadcasting stations a special two-year upgrading programme for their work in the rural regions of their own countries.

The Federal Republic of Germany supports CIERRO through the provision of advice on institution building, curriculum development, upgrading of instructors and also, in the initial phase, through some teaching activities. In the early years there was an urgent need for advisory services on all these matters. However, the project has now been running for over two years with very positive results without the assignment of German personnel and under the full responsibility of Burkina Faso. Training is at Niveau II of the francophone system and is conducted on the basis of maximum integration of the specialist courses in programme production and technology. The emphasis is on continuous practical work in the rural areas of the host country, which is only possible through close and fruitful cooperation with the management of Radio Rurale Burkina Faso.

In addition, upgrading deliberately includes wide-ranging subjects with significance for the target group (African history, ethnology, sociopsychology, communications science, economics, agriculture, health, etc.). The transfer of specialist knowledge in the narrower sense – i.e. raising professional standards – constitutes the third major component of upgrading.

As a result, CIERRO is highly regarded by both international professional institutes and transmitter stations. Qualified teaching staff are available, the institutional infrastructure has been established, the facilities for programme production and appliance engineering are operative, and teaching and learning materials are on hand.

By the end of the academic year 1985/86 a total of 80 specialists from 16 African countries had undergone upgrading in four training cycles at CIERRO. □

TRAINING AT HOME OR ABROAD

Wherever possible, basic training should be provided locally if high costs are to be avoided. More advanced training in regional centres is often beneficial. Students involved in practical training at the Kenya Institute for Mass Communication based in Nairobi.

by Reinhard Keune

Once training has been recognised as a priority for a growing broadcasting network in a developing country, the management concerned must make a careful choice of training programme. Should trainees study locally or overseas? Where will they fit into the hierarchy on their return? Reinhard Keune of the Friedrich Ebert Stiftung, in Bonn, considers the options which are available to broadcasting managements.

THE role broadcasting can or does play in a developing society has been much debated. There is a consensus, however, that radio, because of its easy and cheap distribution, and television, because of its attraction, can both reinforce changes for the better and also contribute towards stabilising existing problems. The potential of broadcasting as an agent of developmental change will – provided that environmental conditions in politics and economics allow for such a role – depend to a large extent on the expertise of those who run it as far as both technology and content are concerned. Thus, training for broadcasters can make an important contribution towards development.

Under the prevailing economic constraints on broadcasting in developing countries, the importance of training is frequently underestimated. As a result, managers have to fight a vicious circle of low production quality, low technical performance and a lack of skills. This self-perpetuating system of incompetence can only be stopped by means of a carefully planned programme for staff development and training.

One of the first questions to be considered is where staff from developing countries should be trained. Should trainees be exposed to modern methods and technologies in an industrialised country even if they then have to work at home with outdated equipment? It could be argued that local hardware in their home countries will eventually be exchanged for more modern systems for which the trainee would be prepared. It could also be said that, partly due to the progress broadcasters have made over the last couple of decades and partly because transnational equipment producers are no longer providing outdated systems, the gap between broadcasting in the developing and the industrialised world has narrowed. Programme quality has improved in many networks in the south and there is no doubt that every broadcast engineer in the world strives to get the best equipment he can.

But does this mean that training in the north should still be a priority? Many experienced directors general in developing countries would strongly object to such a statement. In the past they have sent numbers of trainees overseas and availed themselves of every offer. Thus, some of their staff have been exposed to a western model of broadcasting in Great Britain, France, Holland or West Germany, while others have been trained in Moscow or Budapest. Another group may have been invited to the United States or to non-aligned countries like Yugoslavia or India who offer scholarships either directly or via UNESCO's International Programme for the Development of Communication (IPDC).

Simply because the technical design of a radio studio or a television transmitter does not involve any considerations of political or religious doctrine, broadcast technicians might suffer less from such a heterogeneous mix of professional backgrounds than people concerned with programme content. However, the accumulation of diverse experience can certainly add to the existing problems of a broadcasting network in a developing country. Above all, those who are supposed to contribute meaningfully to the building of a national identity or to a country's own concept for progress and development will have been heavily influenced from the outside.

In addition, overseas training may create similar problems to other professions. Some trainees find it so difficult to adjust themselves to living conditions vastly different to their home surroundings that the benefits derived from any training are minimal and a normal career after their return is impossible. Some even remain in the country that offered training and so are lost to broadcasting back home for good.

On the other hand, local training poses a host of similar problems. More often than not the training facilities in or outside the broadcasting system are inadequate. Broadcast managers find it difficult to make provision for training and there is a lack of experienced trainers and training material. In a number of developing countries university departments, schools of journalism or institutes for mass communication training have been set up to shoulder the burden of broadcast training instead of the networks themselves. But again they suffer from insufficient equipment, training materials, text books, qualified instructors and other shortcomings.

Taking into account the disadvantages of both overseas and local training, it was only logical to look for a compromise: the planning and setting up of regional training centres catering for the needs of a group of countries which, by means of pooling resources, could be adequately equipped with modern technology and attract a sufficient number of experienced teachers. Regional training institutes would thus be able to avoid the effects of alienation inevitable with overseas training and to overcome the deficiencies of local training programmes.

In the early and mid-seventies, regional institutions like the Asia-Pacific Institute for Broadcasting Development (AIBD) in Kuala Lumpur and the Caribbean Institute for Mass Communication (CARIMAC) in Jamaica were established to bridge the existing contradictions between overseas and local training. However, the idea of pooling national resources for a regional training centre took some time to penetrate the minds of policy makers and national administrators. International organisations and donor agencies from outside the region such as the United Nations Development Programme (UNDP), UNESCO/IPDC, the Canadian International Development Agency (CIDA) and the German Friedrich Ebert Stiftung had to fund and organise a large number of training programmes, while Asian countries only hesitantly joined the intergovernmental council presiding over the AIBD and stepped up their contributions in a rather slow way.

CARIMAC, based in Jamaica, suffers even more severely from lack of regional support. However, centres like AIBD and CARIMAC, as well as others in the developing world, have amply proved their value and have been quite effective in fulfilling training needs over the last decade and more.

Clearly, neither local nor regional or overseas training is ideal in itself. The only real answer to the problem facing managers and directors general is to design their own, individual master plan for training and staff development. From a cost-benefit point of view, basic training in broadcast engineering and programming should be handled within the country wherever possible.

For more advanced instruction a carefully selected number of trainees could then be sent to courses and workshops held at subregional or regional level in order to share experiences and to profit from problem solutions that may have proved successful in other regional broadcasting systems.

Only after these avenues have been explored, should the use of overseas training offers at carefully chosen venues be considered for hand-picked staff members. After upgrading their skills, the latter should then fill adequate higher-ranking positions within the broadcast hierarchy.

Reality more often than not contrasts sharply with this ideal procedure, however. Managers and staff development officers tend to make use of every possible training opportunity on offer due to the lack of training facilities within their own country, regardless of the professional qualifications previously acquired by the candidate.

A publication of the Asian Mass Communication Research and Information Centre (AMIC) offers a model of how to arrive at a master plan for training and staff development. A given station is broken up into departmental modules, the necessary staff skills are analysed and ways and means to acquire them are described for each and every position within the network. Once this groundwork has been laid, management will find it much easier to apply this pattern to its own needs and goals and to identify appropriate training opportunities.

Analysis of training needs, however, will remain a fruitless effort as long as the broadcasting system is not prepared or able to adjust its staff recruitment and development strategy accordingly.

A successfully trained and well motivated trainee returning home from an overseas or regional course will soon fall prey to frustration if there is no position available in which he or she can apply a higher level of skills. Sometimes the candidate is promoted automatically to a higher and better paid post because of his or her new qualifications, but within a totally different department where the fruits of expensive training prove to be useless and inapplicable. Since many government-controlled broadcasting networks follow civil service rules and regulations rather than job performance this waste of talent and skills occurs quite frequently.

Another problem is the low salaries paid in accordance with civil service scales. A broadcast engineer who has been sent on overseas training thanks to his employer may find it difficult to accept the same or only a slightly increased salary compared to what he earned before, and he might be tempted to seek employment in private business with higher pay. The same might happen to a good television or film producer, a cameraman or a sound operator.

Bonding can only be a limited answer to this problem, because unsatisfactory work and pay conditions during the bonding period will certainly result in frustration and low job performance.

Training opportunities are available at various levels, but the right offers must be identified within a rather sophisticated network of institutions and with a clear policy for manpower development in mind. Engineering training for broadcasting, for example, is frequently conceived as an extension of telecommunications engineering instruction, although operators, technicians and engineers in broadcasting may have different backgrounds such as on-the-job training, middle-level technical and degree courses in electronic engineering, etc. Coordination of technical training between broadcasting and national PTT – at least at lower and middle levels – can therefore sometimes help to improve results.

For broadcast programme and production training, opportunities are even more varied. Practical instruction courses and workshops range from a duration of one week to several months. Diploma courses usually take two to four semesters and degree courses in journalism, mass communication or broadcasting may stretch over a period of three to five years. To avoid waste of financial and manpower resources, management must make a careful selection of these various levels and opportunities.

While in the past training institutes tended to hide their wealth of experience and material jealously from newcomers on the scene, there is now a greater willingness to share tested curricula, text books, audiovisual material and even instructors, trainers and consultants. It is to be hoped that this cooperative attitude can help to improve the provision of effective broadcasting training in developing countries.

□

For further reference and detailed information some training institutes are listed below.

National: Sri Lanka Television Training Institute, Colombo, Sri Lanka/Multi Media Training Centre, Yogyakarta, Indonesia/National Film and Television Institute, Accra, Ghana/Kenya Institute for Mass Communication, Nairobi, Kenya

Regional: Asia-Pacific Institute for Broadcasting Development, Kuala Lumpur, Malaysia/Pacific Broadcasting Training and Development, Suva, Fiji/Caribbean Institute for Mass Communication, Kingston.

International: Jamaica/Television Training Centre/West Berlin/Radio Training Centre of Voice of Germany, Cologne, West Germany/Radio Nederland Training Centre, Hilversum, Netherlands/British Broadcasting Corporation, London, United Kingdom/Institut National de la Communication Audiovisuelle, Bry Sur Marne, France.

A SYSTEM TO SERVE A NATION

by G E Moriarty

Making a choice of transmission method for a new satellite broadcasting service is a complicated task, especially if the system is to cover a large area and is to have scope for expansion. G E Moriarty, Director of Engineering and Property for the Australian Broadcasting Corporation, reports on how the decision to use B-MAC was made.

SINCE the end of 1985 the Australian Broadcasting Corporation (ABC) has commissioned a comprehensive range of satellite broadcast services. For the first time it has provided a truly national service, with broadcasts of ABC television and three of its radio networks being made from the newly commissioned Australian Domestic Satellite System, Aussat. Although the level of service was not designed to meet the full criterion for strict direct broadcast satellite television (DBS), the broadcasts do provide a level of quasi DBS which is cost effective and serves the needs of the remote areas of Australia. It should be remembered that Australia has a comparatively small population scattered across a huge continent, which makes terrestrial methods of broadcasting impossibly expensive, particularly for the remote rural inhabitants. It is estimated that 300,000 people are outside the terrestrial coverage of ABC television and radio. The satellite is used to transmit television and radio signals into five separate zonal beams which can be received directly by remote area residents, and are used to feed the ABC terrestrial transmitters.

This remote area satellite broadcast service run by the ABC is called HACBSS (Home and Community Broadcasting Satellite Service). It uses a new method of transmitting the television and radio signals to the receiver called B-MAC. As such, the ABC HACBSS service has pioneered internationally the use of this advanced television encoding technique, thereby replacing PAL, which is used within Australia for terrestrial television transmission.

The B-MAC television system, in addition to providing two audio channels for television programmes, is able to 'piggy back' four high-quality audio and/or data channels in a similar way that teletext data is carried within the television signal. In this way, the ABC is able to transmit three of its national radio networks to all HACBSS receivers together with ABC television.

As well as providing a direct to-the-home service to remote users, the ABC HACBSS transmissions are used to feed regional television and radio transmitters. This has allowed much of the extensive terrestrial transmission distribution network to be relinquished, with significant cost savings.

There has been much discussion and debate over the MAC encoding technique, particularly in Europe where two versions, C-MAC and D2-MAC, will be used for satellite services. All of the MAC systems have similar basic vision parameters but beyond that they differ in significant detail in their sound and data facilities.

MAC is an acronym formed from 'multiplexed analogue components' which describes the system in technical terms. In the MAC system the luminance (black and white) and the colour components of the signal are transmitted sequentially during a television line period and reassembled at the receiver. In the PAL system the colour information is carried on a sub-carrier within the luminance signal and extracted from the luminance signal in the receiver.

The MAC encoding system is able to achieve improved technical quality compared with PAL and other earlier encoding techniques. Because the two components of the colour television signal (luminance and colour) are kept separate in MAC, they are not able to interact and cause what is known as cross colour degradation and loss of fine picture detail. Thus the colour definition and picture detail can be somewhat sharper in a MAC signal compared with PAL. Another improvement is the reduced visibility of noise in the colour signal. This is because of the absence of any high-energy sub-carrier at the upper end of the television signal which can cause noise, particularly in satellite transmitted signals.

MAC requires that the signal to the receiver be stored on a line by line basis and time expanded before reproduction on the screen, so that both luminance and colour component signals occupy the full line period. Such systems were not practical for consumer equipment a few years ago because of the lack of low-cost signal storage systems. Modern integrated circuit techniques have overcome this problem.

The prefix 'B', 'C' or 'D2' designates the particular method of carrying the audio signals. The 'B' system that Australia has adopted provides for six high-quality audio channels using a digital delta modulation technique developed by Dolby. These are carried in the line blanking period of the television signal, the latter being unused time between the end of one line and the beginning of the next so that receivers can commence scanning the new line aligned to the picture tube margin.

Australia had to choose a satellite transmission system in the very early days of MAC development. The selection of one of the MAC family was made in order to meet the objectives of the planned ABC satellite service, which was to provide not only ABC television but also three ABC radio channels to all areas of Australia in the most cost-effective manner. The decision to provide radio satellite services as well as television was based on a survey which indicated that people in remote areas placed a high priority on radio as a possible service from the satellite.

At that time, direct satellite broadcasting of television had been done experimentally using the normal transmission standards, so it was proposed that the standard PAL signal should be used. For radio it was intended that individual channels should be used for each service. This was to allow the ABC to uplink the sound channels independently of television, allowing full operational flexibility. A design was proposed for a 'single channel per carrier' (SCPC) system with five independent carriers in the one 30 Watt transponder. One carrier would carry television and would require most of the power and bandwidth. The remaining, smaller, carriers would provide four sound channels which would provide two mono services and one stereo service.

This scheme, although attractive because of its operational flexibility, suffered from a number of problems. The first to become apparent was that provision of all the radio services would compromise the performance of the television signal. Eventually, in order to have adequate television performance, it was considered necessary to limit radio to only two channels. A second problem was that the performance of the radio channels, at least as received on the individual earth stations, would never be better than mediocre. Because of the poor frequency stability of domestic grade equipment operating at the satellite frequency, a special receiver would be needed. Manufacturers were not prepared to provide these receivers at reasonable cost.

As well as the inherent improvements in colour quality possible with the new MAC encoding technique, it was expected that the B-MAC signal would be more resilient to interference and would produce higher quality service than PAL under adverse transmission

Fig 1: *Compositions of a PAL/SECAM/NTSC signal transmitted by frequency multiplexing, showing the simultaneous transmission of sound, chroma and luminance elements in different but overlapping parts of the frequency band. Note the cross-over effects.* ***Fig 2:*** *Transmission of a MAC signal during the time taken to send one line (64 μs). Chroma, luminance and sound signals are transmitted by time multiplexing instead of frequency multiplexing as in present systems. Cross effects are avoided, and by applying the full bandwidth to all three components, picture quality is improved. Courtesy of Philips.*

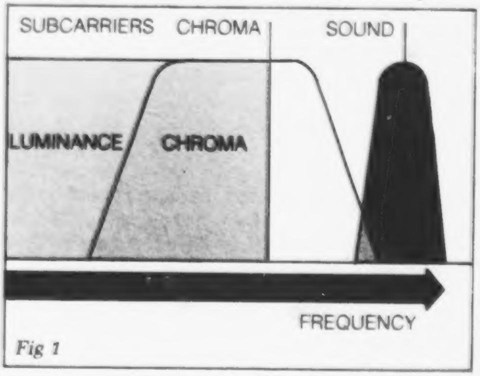


Fig 1

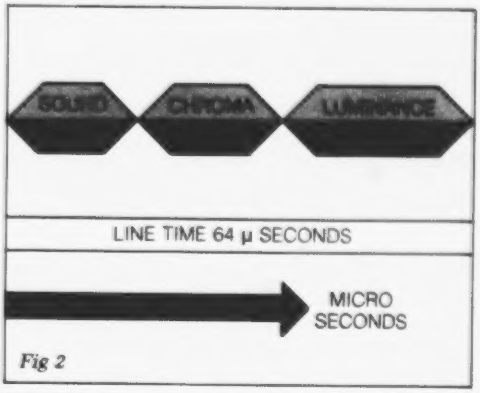
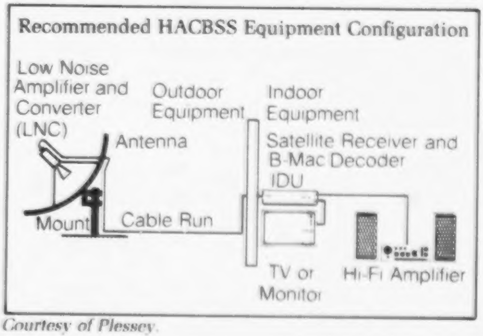


Fig 2



Recommended HACBSS Equipment Configuration

Courtesy of Plessey.

conditions caused by rain or by electrical disturbances.

In September 1984, when the Australian government selected B-MAC, and specifically the Scientific Atlanta version (i.e. SA-B-MAC) as the national satellite transmission standard, it was understood to be the only MAC standard that could be produced in sufficient quantities to allow a public service to begin in the last quarter of 1985.

The initial market penetration of B-MAC receiving equipment was slow but this is expected to increase as the Remote Commercial Television Services get under way. It is planned that each footprint region in Australia will have a commercial satellite service as well as the ABC one.

The technical performance has so far met the expectations at the time of selecting the standard and the HACBSS service has proved to be capable of very high quality. Most of the terrestrial television and radio transmitters formerly fed from long microwave links have been cut over to be fed from receive-only earth stations via the HACBSS signal. As a result, a worthwhile improvement in picture quality has been noticed in many areas of Australia. In addition, the old system of feeding remote regional transmitters via an Intelsat transponder has been replaced by using the HACBSS signal through further receive-only earth stations.

Significant offsets to the cost of operating the HACBSS service have been realised in that one of the zonal footprints, the south-eastern, provides coverage of all the state capital cities except Darwin. The HACBSS signal from this footprint is therefore used for programme distribution from Sydney to the state capitals it covers. With this capability from the satellite it has been possible to restructure ABC television operation by concentrating more on national networking and by abandoning the physical syndication of programme material on videotape to all operating locations. This has achieved further cost savings.

As well as the quasi DBS services described so far, the ABC is making considerable use of the satellite for programme interchange between its radio and television operating locations throughout the country. This use involves a comprehensive system of up and down links, together with one satellite transponder for radio and two for television. In the capital cities the ABC utilises Aussat's earth stations but in regional areas the ABC will be installing its own earth stations at its radio stations.

The Scientific-Atlanta B-MAC system was developed as a television transmission technology optimised for direct-to-home 'pay' television services. A fundamental component of the design is a conditional access capability: This allows independent and individual authorisation of the television, radio, teletext and data services that make up the composite B-MAC signal. The ability to control access to services selectively is determined by the status of service authorisation information transmitted by the broadcaster and stored within the B-MAC decoder in each receiver. If decoders have been authorised for a particular service or services, then they will only process those signals for reception. Access to other services is barred.

Although the ABC does not currently make use of these 'pay' facilities, it was agreed that the possibility of utilising the conditional access capability at some time in the future should be taken into account in introducing the new satellite services. If this were not done from the outset it would be virtually impossible to do it at a later date. Also it is envisaged that B-MAC will be used not only by broadcasters but also by various organisations for a variety of satellite distribution purposes that may not be intended for reception by the general public.

Accordingly a data base of all B-MAC receivers sold within the country has been established. This is maintained by the ABC. So far, with the number of receivers involved, this has not created any significant problems. However, it is acknowledged that maintenance of an accurate data base for a 'free to air' public broadcasting service over a long period of time will be difficult.

To establish the potential use for and to maintain effective use of the conditional access system requires a considerable degree of coordination and cooperation between B-MAC operators in order to prevent service authorisation conflicts. While the technology offers some degree of sophistication to help eliminate such conflicts, there is a need for a system management framework. This has been established by the government's Department of Communications in consultation with the ABC and other potential users and is called the B-MAC Management Plan.

The ABC has thus pioneered the introduction of a very substantial satellite radio and television service, utilising B-MAC technology to provide an appropriate and cost-effective broadcasting service to previously unserved areas of the country. In addition, the data communications possibilities and selectable access capability of the B-MAC system are yet to be realised, although potential applications for their use are being considered. □

TRENDS IN TRANSMITTERS

by Ian Waters

The worldwide demand for broadcasting transmitters is as great as ever, despite the advent of alternative forms of broadcasting. Ian Waters, Product Manager for Transmission Equipment at Pye TVT, looks at the technology now on offer.

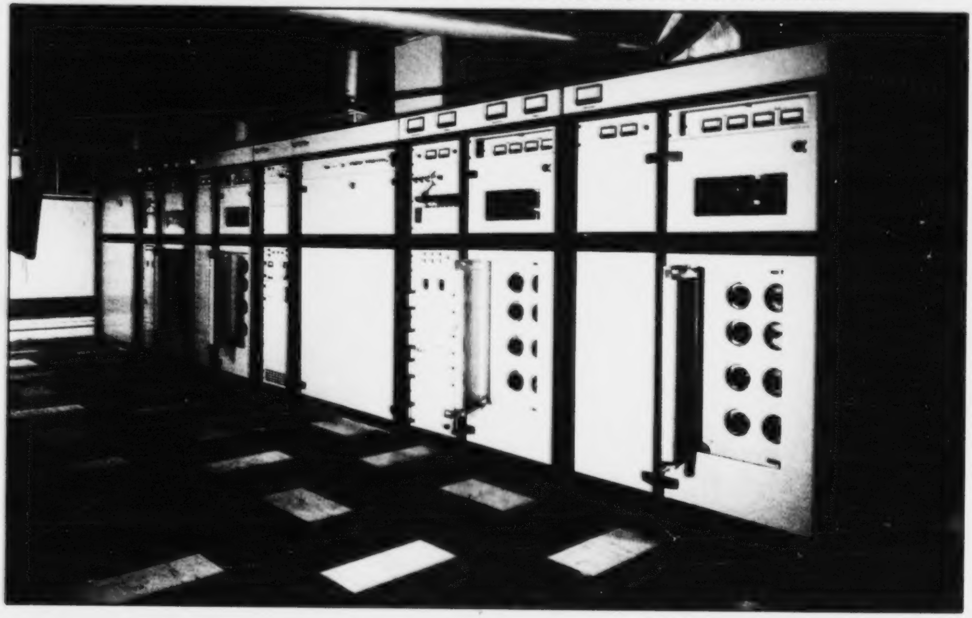
DESPITE all the innovation taking place in such fields as direct broadcast satellite (DBS), high definition television (HDTV), the MAC standards and cable distribution, the expansion of conventional terrestrial broadcasting continues undiminished. Indeed, terrestrial broadcasting is expected to remain the main channel for the public distribution of programmes until well into the next century, not only for extending the coverage of existing programmes but also for the introduction of significant new services in many countries. These include the Third Network in the Netherlands, the SBS Service in Australia, TV3 in Malaysia, some 30 new independent commercial stations each year in the United States and Channel 4 in the United Kingdom.

Many broadcasting services have now been in operation for as long as 35 years and, with the typical lifespan of a well-maintained transmitter being 20 years, equipment is being replaced for the first or second time. In addition, the improved reliability of transmitters means that there is a move towards unattended operation, while a reduction in the size of equipment is releasing space for new services in existing buildings.

Expansion and replacement of equipment are thus currently creating a high worldwide demand for transmitters, with forward planning by many authorities suggesting that this will be the case for some time to come.

The universal trend in television is increasingly towards UHF which does, after all, offer four times as many channels. Naturally, most countries initially exploited VHF and, where there are several services, Band I and III channels are fully used. But even where there are unused VHF channels, planning authorities are guiding new television developments into UHF – a move not always popular with commercial broadcasters who consider themselves at a disadvantage as far as coverage is concerned in comparison with existing VHF competitors. In other areas, existing VHF services, which provide good coverage but are at times subject to interference, are being

Two 25 kW klystron UHF transmitters



relocated on UHF. Meanwhile the United Kingdom, paying the penalty of being first in the field with VHF, has had to recreate its television services from scratch on UHF and abandon all VHF frequencies.

With transmitter performance and transparency to the video and audio signals now generally satisfactory, attention has been focused on reducing operating costs when installing new equipment. These divide into energy consumption, of particular relevance with higher power UHF, and maintenance labour costs. The latter include not only repairs – significantly less with modern equipment anyway – but adjustment in order to keep performance within specification. As to some extent high efficiency is incompatible with good long-term stability, the most cost-effective compromise between energy and labour has to be sought within the operating philosophy of each organisation.

Within UHF, the long-running battle between tetrodes (amplifying power grid vacuum tubes) and klystrons (transit-time vacuum tubes) continues. Over the years the power at which tetrodes may be reliably used has moved upwards and today few would contemplate klystrons at or below 10 kW. From 15 kW to 20 kW the market remains divided with those preferring one techology or the other, but, although a 50 kW UHF tetrode has been offered, the klystron still reigns supreme from 25 kW upwards.

60 kW klystron UHF television transmitter

Within the klystron camp another long-running division between advocates of internal and external cavity tubes seems almost to have been resolved in favour of the external type. Integral tubes, long favoured in the United States and Japan on account of quicker tube replacement, have lost ground to the external cavity types favoured in Europe. These permit more flexible tuning for high efficiency and, being broadband, enable spares to be deployed anywhere in a network. With the most recent Japanese transmitters now employing European tubes, only one significant American manufacturer remains wedded solely to integral cavities.

The question of klystron efficiency is raised when looking at energy costs. In the early 1960s, when klystrons were first used extensively and the accent was on quality and reliability, energy was comparatively cheap and a low vision peak sync efficiency, more accurately referred to as a figure of merit, of about 30 per cent not important. Over the years, as energy costs have risen, improvements in klystron technology have doubled this figure of merit to at least 60 to 65 per cent.

Significant advances in efficiency were achieved in the early 1980s by switching the beam power between a lower level adequate for picture transmission and a higher level, for a short time only, when synchronization is radiated. This was achieved first by pulsing existing modulating anodes, followed by the introduction of annular beam control abc/bcd tubes. Beam control with sync pulsing is now the norm for nearly all new klystron transmitters. At lower powers it makes efficiency comparable with tetrodes, but it is particularly valuable at the higher powers – up to 240 kW – used in the United Kingdom.

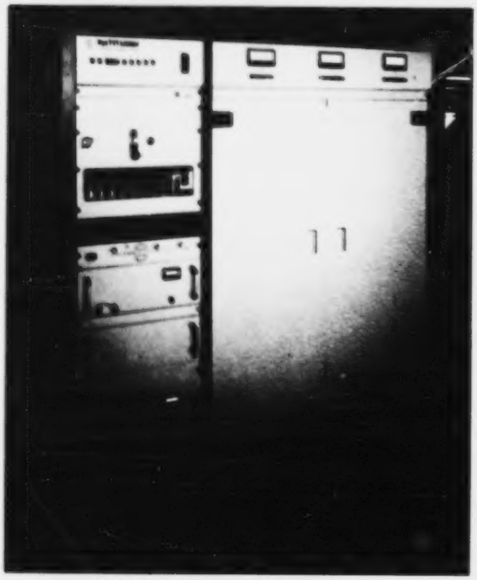
As increasing efficiency requires the tube to operate with black level on the highly non-linear part of the characteristic near saturation, there is a trade-off between efficiency and the degree of pre-correction used. This in turn equates to long-term stability of performance. Considerably higher figures of merit have been achieved but they are, perhaps, unrealisable at present at unattended stations, bearing in mind the need to contain maintenance costs. One solution being tested in the United Kingdom is a microprocessor-controlled automatic adaptive pre-corrector which samples the transmitter output and continuously optimises linearity, differential gain and phase.

Other klystron-based efficiency improvements are being developed on both sides of the Atlantic. In the United Kingdom a klystron using a shadow grid – more sensitive than an annulus – modulated by a full-time video, has been tested. This changes the Class A klystron characteristic to near Class B with beam current varying according to picture brightness. Although complex pre-correction is needed, efficiency is higher than with sync pulsing and a figure of merit of 83 has been achieved experimentally.

In the United States, 60 kW transmitters employing the klystrode are being offered. As the name suggests, this is a cross-breed between the klystron and tetrode. Operating requirements are similar to a klystron except that the gain at 23 dB is lower. Again the tube operates in Class B and a figure of merit as high as 123 has been claimed under certain conditions.

Care is needed when comparing these figures to make allowance for different broadcasting standards and to use a similar average picture power level for reference. If this is done, the spread in efficiencies is less than it appears.

The other American development is the multi-stage depressed collector kylstron. Single-stage depressed collectors were introduced extensively in Europe in the mid-60s, which raised the figure of merit from about 30 to 40. The present programme proposes a four-stage collector to decelerate electrons with differing velocities in the beam after the final cavity in its four segments. The programme aims to achieve a figure of merit of 117, at the expense of power supply and cooling complexity.



5 kW tetrode UHF television transmitter

But what of solid state? The fact that changing television and FM drive and low power RF stages from tubes to transistors over the last 15 years has produced dramatic improvements in quality and reliability is a matter of historical record. Solid state RF power levels have been increasing steadily and time will show whether reliability is maintained at higher powers.

Today the user has the option of hybrid solid state/tube or all solid state designs at some powers. For MF radio solid state is available up to 50 kW, and at Band II FM and Band I and III TV frequencies, the highest powers normally required (i.e. up to 30 kW) are becoming capable of economic solid state realisation.

The application of transistors at UHF has naturally been slower, but sound of 1 kW has become established, while all solid state transmitters of up to 30 kW are being evaluated. So far these tend to be rather large, expensive and inefficient and their use of channel-tuned modules would not be welcome to network operators.

One advantage of solid state, so far not always accepted, is that, as power is produced by a number of parallel amplification chains, the transmitter possesses 'integral modular reserve' which can eliminate the need for conventional reserve systems. But broadcasting engineers are conservative and the next few years will show how far solid state will replace tubes. A possible scenario might be solid state replacing tetrodes at medium powers with klystrons, or some development of them, preferred at high power.

A recent innovation is multi-channel/stereo television sound, of which there are at least four different systems actually in use or proposed. They divide into those which use sub-carriers and those which add a second sound carrier either analogue or digitally modulated. Provided bandwidth is available, sub-carriers can be added relatively easily to new transmitters or in the field. Meanwhile second carrier systems require extensive changes to provide the carrier and amplify it without excessive intermodulation. The broader band versions also need vision/sound combiners with a band-pass sound channel. Most transmitters are now being supplied fitted for stereo, although its use is as yet limited by programme material and stereo links to transmitter sites.

As for radio, despite VHF/FM, MF services seem set to continue, with equipment replacement often solid state. The use of AM stereo in the United States appears to be confused and it has made little impact elsewhere. FM is expanding with new services and replacement normally using solid state for all but the higher powers. Frequency agile drives and broadband amplifiers are making the N+1 reserve system attractive. The majority of services are now in stereo, while the FMX system in the United States aims at improved signal to noise ratio. The base band is being increasingly loaded with one or more SCA sub-carriers for various applications. ☐

Television is still an unobtainable luxury for many people in India, especially for those living in remote areas. Photo courtesy of COMPIX – Commonwealth Institute.

KASHMIR TO KAN
PH

SOLAR POWERED TELEVISION TRANSMISSION

by M M Asthana

Two major problems that face organisations in the Third World attempting to take a broadcasting service to remote areas of low population are maintenance of equipment and a reliable power supply. M M Asthana, Chief Engineer of Doordarshan of India, explains how they have overcome both these difficulties with some very adaptable and economic technology.

IN INDIA the expansion of the television network is planned with the help of high-power and low-power television transmitters. In general, 10 kW, 1 kW and 100 W transmitters are in use.

There are parts of the country, however, which are isolated or in remote mountainous areas which cannot be reached by television signals. Such places have a comparatively low concentration of population. To provide a television service, 10 W very low power television transmitters (VLPT) have been envisaged. These transmitters operate on solar power and thus eliminate the need for mains power supply. Dual transmitters and dual related electronics have been provided so that active standby is available in each case. The transmitters are designed to operate entirely unattended.

This means that they can be located at technically ideal sites in order to provide maximum coverage. India, as well as most of

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the countries in the Asia and Pacific region, receive abundant sunshine. Solar photovoltaic panels therefore offer an ideal solution for providing power supply to VLPTs at remote locations. Absence of voltage fluctuations in solar-operated supplies further reduce equipment failures.

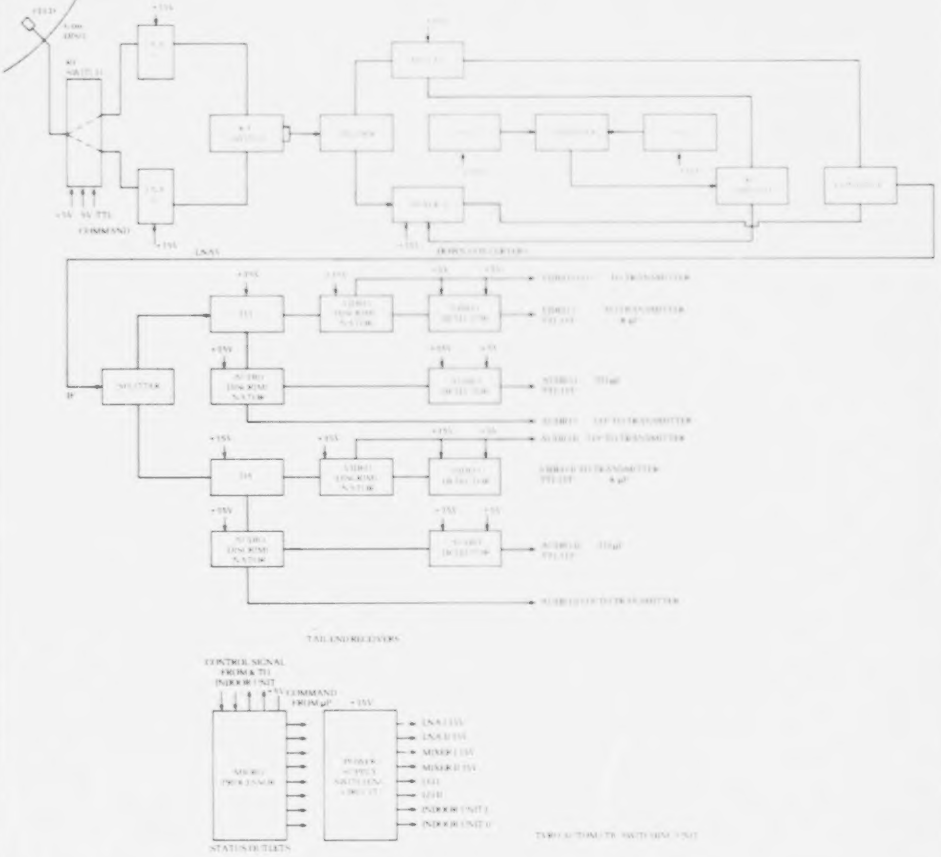
S-band television receive only (TVRO) facility has been used for feeding television programme signals to the transmitters. The Indian National Satellite (Insat-IB) provides signals to such VLPTs throughout the country. However, signals can also be received from C-band transponders of conventional satellites by providing C-band TVROs.

All equipment operates from a 24 volt DC supply. Active standby units have been provided in both the TVRO and transmitter. The control circuits of TVRO and transmitter provide sequential switching of various stages, the facility to switch over to the standby unit in the case of operating unit malfunctions, recycling of stages in case of momentary failures, assignment of a particular set of combinations when all units are healthy, and indications of status and fault conditions. All functions are automatic. A portion of the TVRO always remains energised to sense the presence of line syncs in the video signal from the satellite. When line sync pulses are present the remaining portion of the TVRO and transmitter are energised. The control system is flexible and its software can be reprogrammed to suit the operating modes desired. To limit the drain on the solar power supply, minimum electronics are kept energised. The power requirement is 30 W in the absence of line sync pulses and 160 W when the system is fully energised. Both the TVRO and transmitter also have manual switching modes in case the auto mode malfunctions.

S-band TVRO has a dish six metres in diameter. Dual electronics have been provided in low noise amplifier (LNA), down converter, local oscillator and tail-end receiver. Dual LNA are mounted at the feed point. The TVRO operates on 2575 MHz. Pin diodes have been used for switching and the automatic switching unit is microprocessor-based. A DC-DC convertor type switch mode power supply unit checks all TVRO units in sequence in the first two minutes. Switching is in order of eight combinations. Video and audio signals from the TVRO are routed to the changeover unit of the VLPT. Control signals go to the microprocessor-based automatic switching unit of the VLPT.

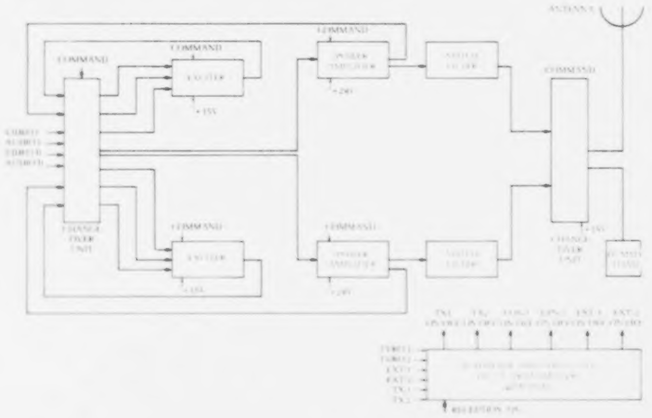
The VLPT consists of two 10 W transmitters with redundancy in exciter and power amplifier stages. In addition, it contains one

Figure 1: **S-BAND TVRO**



+15V
RF SWITCH
COMMAND
+15V
SPLITTER
TAIL END RECEIVERS
CONTROL SIGNAL FROM & TO INDOOR UNIT
+5V
COMMAND FROM μP
+15V
LNA I 15V
LNA II 15V
MIXER I 15V
MIXER II 15V
INDOOR UNIT I
INDOOR UNIT II
STATUS OUTLETS

Figure 2: **2 × 10W VERY LOW POWER T.V. TRANSMITTER (VLPT)**



ANTENNA
COMMAND
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+24V
+15V
CHANGE OVER UNIT
TX1
TX2
EXT1
EXT2
TX1
TX2

Type	SPV Peak Watts	No. of solar panels		Remarks
		6 modules	4 modules	
A	770 W	2	4	Least sunshine
B	700 W	1	5	Medium sunshine
C	615 W	0	6	Maximum sunshine

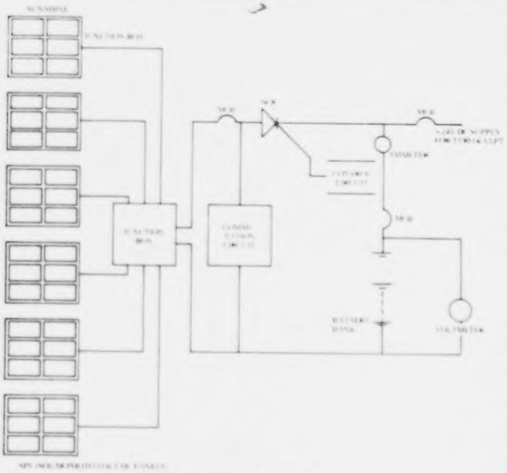


Figure 3: **SOLAR POWER SUPPLY**

changeover unit at exciter inputs and another changeover unit at transmitter outputs to the antenna system. Mechanical relay switching has been avoided both in the TVRO and in the transmitter in order to increase equipment reliability.

One of the transmitters gets energised after receiving a command signal from the TVRO automatic switching unit. Any exciter and power amplifier combinations are possible and are selected automatically depending upon the health of the units. When all units are working, the exciter 1 and power amplifier 1 combination is automatically assigned. The transmitter recycles five times in case of intermittent malfunctioning in either both the exciter units or both the power amplifier units. When a fault has still not cleared, the transmitter finally switches off and a maintenance team has to make a visit.

A light-weight 30-metre mast, with a 3 dB gain, is provided at most of the locations so as to cover an eight-kilometre radius. Coverage could be greater with the use of directional antennae, depending upon the target area to be served.

The number of photovoltaic panels to be mounted depends upon the average sunshine available over a one-year period. The following table gives an idea of what is needed to meet the power supply requirement for TVRO and VLPT.

The panels supply power to charge 12 two-volt industrial type battery cells. Initial charging has to be done by conventional battery chargers. Solar panels are then able to maintain the charge and can charge up to 70 per cent of the battery discharge. The battery capacity has been chosen so as to keep a VLPT installation working for four days without sunshine.

VLPT transmitters are designed to operate on the basis of a 15-hour day. The control circuit of solar power supply has provision for disconnecting the solar panels from the battery in case of overcharging, cutting the load when the minimum permissible battery voltage is reached and maintaining charging current.

It is useful to mount the solar panels on the roof of the transmitter building, with the latter placed so as to gain maximum sunshine for the panels, depending on the latitude of the location. The solar panels can be adjusted to three different inclination angles. Maintenance staff change the panel inclination to the desired angle depending on the time of year. A continuous sun-tracking arrangement is not used for practical reasons.

A thousand square metres of land is considered sufficient for the installation of the TVRO dish, solar panels, a 30-metre mast and the VLPT. A floor area of 28 square metres is adequate for the transmitter building. This contains a large room for the VLPT and TVRO electronics and a smaller room for the bank of battery cells. The battery room is ventilated and insulated from the equipment room. As many locations are remote, it would be useful to provide a rainwater collection arrangement in the building and maintenance staff could use the water for cleaning purposes during their visits.

India proposes to install a number of such VLPT transmitters to meet the needs of people living in remote, isolated and hilly areas. Such a system would be very reliable as it does not depend upon stable mains power supply and redundancy in equipment has been provided. Because of unattended operation, recurring expenditure would be minimal and an ideal site could be selected to provide maximum coverage. □

This article is reprinted courtesy of the ABU Technical Review, published by the Asia-Pacific Broadcasting Union.

COMMUNICATIONS STRUCTURES: SPECIFYING THE BEST DESIGN

by Don Marshall

The structures that support the equipment for any communications network are themselves crucial to its efficient operation. Don Marshall, Director of Engineering at LeBlanc & Royle Telecom Inc., summarises the factors that must be taken into account at the design stage.

A COMMUNICATIONS structure usually plays a secondary or, literally, a supporting role to the main transmitting and receiving antennae in a communications network. Yet its function is critical to the overall operation of the system. After all, a structural failure can black out the entire network.

The key to good performance is the preparation of thorough specification before the structure is designed and built. To achieve this, there are a number of decisions which the purchase or project manager must make to obtain the best performance at the most economical price.

Applicable standards

Reference to a recognised standard for communications structures will greatly simplify any specification and ensure a uniformity of proposals for the project. It is important to note that the standards should be for masts and towers. Reference to building codes without some qualification will only cause confusion. Communications towers are a special type structure and must be recognised as such.

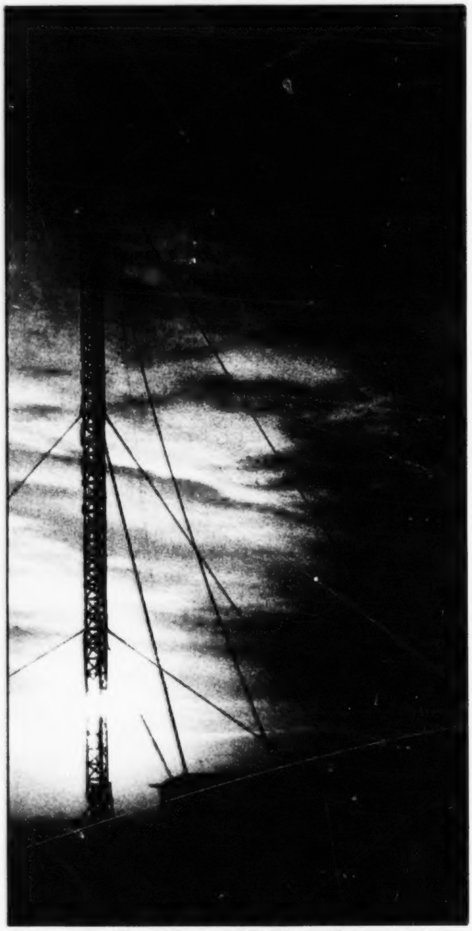
EIA (Electronic Industrial Association) Standard RS-222 is the American standard for communications towers. It is very simple and straightforward in its approach, but it lacks some of the sophistication of other standards. However, it is being updated to incorporate the latest data on the subject.

Canadian Standards Association Standard S37 for antennae, towers and antenna supporting structures provides a very good standard which has just been updated to keep it current with the latest developments.

Other national standards may also be applicable, depending on the location of the project. However the EIA (Electronic Industries Association) and CSA (Canadian Standards Association) standards are used in many areas of the world.

Types of structure

So how does one choose the right type of structure for a particular project? Should it be self-supporting? Square or triangular? Steel, concrete or wood? Unless there are special circumstances, it is best to leave these choices to the firms making the proposal. However, a



***Above:** The flexibility and lightweight construction of guyed towers make them capable of withstanding earthquakes. If there is any earth movement the guy cables can allow for this without causing too much stress to the tower shaft itself.*

brief overview will provide an insight into the advantages and disadvantages of the various types.

(a) Guyed structures – For heights over 10 or 15 metres, this will provide the most economical structure. However, in some areas, they tend to be over-engineered and hence overly expensive. This is primarily due to the non-linear nature of the structure and a very conservative approach by those not experienced in this type. However, with the correct engineering and computer programs it is by far the most suitable structure. This is because:

- ☐ mounting of antennae and transmission lines, particularly at different levels, is greatly simplified;
- ☐ they adapt to uneven terrain;
- ☐ location of foundations is not critical;
- ☐ tilt and twist can be controlled to match required performance;
- ☐ they are easily and quickly erected;
- ☐ there are economies of scale in fabrication.

A triangular configuration is the most common and the most economical type. The three legs, faces of bracing, anchors, etc., versus four for a square configuration, represents a significant saving. The reduced wind loading is also important. The fabrication of the leg members requires special techniques, especially for angle member towers. However, this is no problem for a tower manufacturer equipped for this type of work.

(b) Self-supporting structures – Except for quite short structures, these will be more expensive than a guyed structure. For heights above 90 metres their cost becomes almost prohibitive, unless there are special circumstances. This type of structure is used where the site size is limited and/or the cost of land is very high. Typically, they are used in the cities, while guyed structures are used in the open country.

A self-supporting tower may be either square or triangular. If deflections are important, the square type is preferable.

(c) Construction materials – Galvanised steel is the main material used for communications structures. It provides the most economical structure and a long, maintenance-free life. Towers of aluminium, concrete and wood have been used for special applications, but they have not been without their problems.

Loading conditions

Wind, and icing where applicable, are the most significant loads affecting the design of a communications structure. It is vitally important that the purchaser understands what is required and ensures that the correct data is provided. If the specified loading is lower than required it could endanger the structure. If it is too high then the structure will be too costly.

Wind loads

The relationship between wind pressure and wind velocity is given by

$$q = k\,v^2$$

where q = dynamic design wind pressure.

k is a constant depending on the units being used.

$k = 0.613$ when v = m/s
q = n/m
$k = 0.00256$ when v = mph
q = pounds force

q is then modified by the appropriate factors, for the specified standard, to account for:

- ☐ increased velocity with height;
- ☐ the gustiness of the wind;
- ☐ the shape or drag factor for the structure and/or attachments;
- ☐ special siting considerations.

Obtaining the correct value for v is the critical item. There are several different methods of recording wind velocities. This depends on the equipment and methods used by the meteorological service in the country reporting the data. The wind velocity may be

- ☐ an average one hour velocity
- ☐ the fastest mile of wind
- ☐ a five-minute velocity
- ☐ a three-second gust velocity

Which one is reported will also affect the magnitude of the appropriate gust factor to be used with it.

For design purposes, a 30-year or 50-year return period is used. An overload factor (usually 1.5) is then used to allow for the chance of a greater storm, and also to cover variations from the meteorological reporting station and the actual tower site. Alternatively, the overload factor may be part of the design of the members in the structure. The method will depend on the structural code or standard being specified.

The overload factor is sometimes included in the specified wind velocity. If this is done and a code which has an overload factor in the design of the members is specified, the structure will be too heavy and hence more costly than is warranted.

Some specifications will use terminology such as 'will survive' or 'shall withstand'. This can be taken to imply that the overload factor is already incorporated in the specified wind velocity. It is important that the intentions and the requirements for the particular project be clearly defined.

These factors all have to be taken into consideration in order to ensure that the structure will survive all reasonable loading conditions to which it may be subjected. In point-to-point communications, however, it is reasonable to expect some loss of signal during very infrequent extreme storms. Therefore, a second lower wind velocity should be specified to use with the allowable tilt and twist values for directional antennae. With the increasing use of higher frequency systems, this is becoming a more significant factor in tower designs because these systems use antennae which have smaller allowable deflections. This is also true for broadcast operations. People are not likely to be watching and/or listening during these extreme conditions, but will need these services once the storm is over.

It is not feasible to design towers to survive tornados or other very extreme and localised storms, but hurricanes and typhoons must be considered.

Earthquakes

Guyed structures are lightweight and flexible and hence are not affected significantly by earthquakes. Usually the specified wind loading is much greater than the likely effect of any earthquake and this tends to govern the design of the structure. The guy cables allow for any movement of the earth without causing any overstresses in the tower shaft. The foundations, particularly the base pier, require more careful study for lateral loads, but are not a major engineering problem.

Self-supporting structures are more critical. The wider fixed base makes them more susceptible to ground movements. A heavy concentration of weight near the top may produce some high stresses, but this can easily be handled in the analysis.

With the seismic zone well defined, the design of the structure and foundations for these conditions do not present any difficult engineering problems.

Icing

Icing will occur in the northern and southern regions of the globe and at high altitudes. It must be considered in the design if the structure is to be located in these areas. Unfortunately, there are few records available to assist the specification writer. In Canada, values have been assigned to the various regions as a guide to the designer, and these are proving to be successful.

Equipment

Except for radiating towers, the purpose of a communications tower is to support some particular electronic equipment. This is usually a transmit/receive antenna(e) with its associated feed lines.

It is important that all the equipment concerned, both for the present and future, be fully documented for the designer. The minimum data would consist of:

☐ the type and size of the antenna(e);
☐ the frequency of the signal;
☐ the number and size of the feed lines;
☐ elevation relative to the ground datum;
☐ deflection limitations.

The performance of the antenna in terms of fade margins is critical. Thus the deflection, the tilt (rotation about the vertical axis) and twist (rotation in the horizontal plane) are important. In microwave applications this is dependent on the size of antenna and frequency.

Interfacing between the equipment and the structure is of critical importance and is an area that causes the greatest amount of problems. Detailed consideration of all the factors involved is vital to a successful project.

Obstruction markings

For most communications structures over 20 metres in height some form of obstruction marking is usually required for aircraft warning. The requirements will depend on the particular regulations of the country. The purchaser should identify the requirements that will govern the project. In some areas the local authorities may waive certain requirements because the structure will not present a hazard to aircraft. If the country does not have any particular requirements, then other recognised standards should be specified.

The International Civil Aviation Organisation (ICAO) standard is used in many parts of the world. While it mainly deals with markings in and around aerodromes, it also covers the general siting of towers.

Conclusion

Communications structures, whether they are the tallest of broadcast structures or the smallest towers, require special considerations and engineering to ensure successful and problem-free installation and system performance. The involvement of experienced engineers and contractors is clearly important. Above all, however, to ensure that the purchaser obtains what he requires, a carefully constructed and thorough technical specification is essential. ☐

Above: *A minimum of three rooms is necessary for an operational radio station: a control room, an acoustically treated studio for live broadcasts and a room for the transmitter. Photo courtesy of Cable and Wireless.* **Below:** *Sound broadcasting is still the most cost-effective way of providing entertainment, information and educational material for remote audiences. Photo courtesy of ITU.*

BASIC TOOLS FOR A RADIO STATION

by Irfan Ullah

Despite phenomenal advances in communications technology worldwide, there are still small communities that can only be reached by radio. Irfan Ullah, Director of Engineering of the Pakistan Broadcasting Corporation, lists the minimum requirements for a radio station to become operational.

A RADIO receiver is still the only really effective way of communicating with people living in the remote areas of developing countries, especially when they lack any other means of mass communication such as newspapers, magazines or television. Most of these areas do not even have proper roads, waterways or other means of contact. Thus the provision of sound broadcasting services in developing countries is the most cost-effective and satisfactory way of being able to reach people.

There are various types of radio coverage available such as low frequency, medium frequency, high frequency and FM coverage. The most cost-effective is high frequency coverage in the bands allocated by the radio regulations for tropical broadcasting. The transmission power required to cover a given distance in these tropical broadcasting bands is fairly low, as quite large distances can be covered easily through reflection from ionised layers of the upper atmosphere, especially after sunset and before sunrise. This kind of broadcasting is already being used extensively in tropical countries.

Another advantage is the fact that the ranges are not so large as to interfere with neighbouring countries. Hence coordination for minimising the interference can be easier. The special high frequency bands below 6 MHz are distinct from the high frequency broadcasting bands above 6 MHz, which are used mostly for long-distance broadcasting. The latter are highly congested and are not recommended for domestic use.

The programmes produced by a radio station should provide entertainment, information and educational value. Thus, the following kinds of programmes are required:

- ☐ live coverage of sports events, functions, etc.;
- ☐ programmes run by a disc jockey or compere who intersperses recorded material with topical conversation (ie a major portion of the programmes broadcast come under this category);
- ☐ relay of events taking place at a remote location via a telephone link to the radio station.

The transmitter and its antenna system are essential requirements of the radio station. A transmitter of up to 10 kW is quite sufficient to meet the coverage requirements of distances up to 500 kilometres in the tropical bands of frequencies. Modern solid state technology has enabled very small transmitters with this capability to be produced, requiring little power consumption and space. The use of solid state equipment needs care, however, because it is rather delicate in nature, needing proper protection against transient surges of voltage in the power supply. Such variations are quite common in developing countries and should be avoided with the use of transient suppression equipment.

The antenna for this particular kind of transmitter is generally of a type that radiates most of its energy widely, reflected downward like a shower over the entire reception area. Such antennae have been specially designed for the purpose and details are available from the International Consultative Committee on Radio (CCIR).

In order to make the radio station cost effective, the transmitter and studio should be located in the same building. This will cut down on staff as well as reducing transport costs to a transmitter site. However, this does mean that the studio equipment will need protection from the transmitter, in order to avoid interference in studio operations. This is entirely feasible with modern techniques and for the power levels concerned.

The minimum area needed for a radio station is three rooms: one for the transmitter, a second for the control room and a third as an acoustically treated studio for live broadcasts. There should also be sufficient land around the building to allow for installation of the antenna.

The control room normally consists of a control console, with provision for playing discs, cassettes and tapes, for several microphone channels coming from the studio itself, as well as input from telephone lines for outside broadcast purposes and relay from other towns through telephone link-up.

Generally, there are two types of microphone available. Preferable, and more economical, is the dynamic type. The condenser type requires an additional power supply and thus is too complicated for most situations.

The recording equipment usually consists of three major elements: a normal turntable, able to play back discs; a cassette recorder, able to record as well as play back material (especially useful now that most music is available in cassette form) and for use in outside broadcasts; and a tape recorder, which has the additional benefit of dubbing and editing capabilities.

Outside broadcasts can be achieved either by using cassette recorders on the spot or, when material is of immediate topical interest, using telephone lines linked up with the radio station. Outside broadcast amplifiers and cassette recorders are available in solid state form and thus are both highly portable and light on battery power.

The major requirement for a studio is that it should not be in a room that is too long or cube-shaped as this can cause resonance. Preferably, the three dimensions of the room should be different. In addition, it needs to be acoustically treated. This can be achieved with heavy carpets and thick curtains on the walls, though some absorption material may also be necessary on the ceiling if the studio is going to be used for speech to any great extent. The furniture should also be padded.

The main capital investment involved in setting up a radio station is the cost of the land, building, equipment and its installation, though these vary according to location and other available facilities. The running costs of a radio station include staff wages, electricity bills, payments to casually-employed contributors and maintenance of equipment. Staff able to look after the administration of the station as well as its operations can cut costs considerably. ☐

***Above:* The chips in a CCD camera do not deteriorate and need never be replaced, ensuring that the camera is permanently aligned.**

CHOOSING CAMERAS FOR HIGH QUALITY PERFORMANCE

New technology is constantly improving quality at the same time as bringing down prices, a trend which can only be beneficial for developing countries embarking upon investment in broadcasting equipment. Phil Parker describes the latest advances in field cameras.

by Phil Parker

THE importance of a broadcasting television service for a new or developing country has long been recognised. This is especially the case if the service concerned is one that produces indigenous programming for entertainment and education. Yet unfortunately the cost of full broadcast standard equipment has in the past tended to limit the scope and extent of what could be attempted.

The revolution in consumer video products that has taken place, principally due to the Japanese and the ubiquitous microchip, has gone a long way to alleviate this problem. Recent developments have produced equipment of near broadcast quality for prices previously only associated with low-performance equipment.

Camera equipment is obviously one of the most crucial investments for a small, possibly recently established company. In particular, field and dedicated purpose cameras, for use in documentary, news and other outdoor filming, are important for most broadcasting organisations, as this kind of work forms a major part of programming.

Broadcast cameras have always tended to be difficult to adjust and keep aligned, especially in field use. The fully fledged broadcast cameras as used in the major networks are, of course, full of computers which perform automatic adjustment and diagnostics, but these can cost $80,000 or so and are thus far beyond the means of the embryo or developing company.

Yet even these computers cannot compensate for misalignment of the camera tubes caused by severe mechanical shock. New devices have minimised the problems, however, and have eliminated the necessity for tube alignment altogether.

One of the principal advances has been the charge coupled device (CCD), a solid state replacement for the pick-up tubes used in normal cameras. This is far less fragile and should never need to be replaced unless actually damaged.

These devices have been available for some time and do, in fact, form the basis of most consumer cameras. But only recently has it been possible to manufacture chips with enough yield to make them economically viable and with sufficient pixels to give adequate resolution and freedom from defects for high-quality pictures. The use of new 'offset' technology in horizontally displacing the green chip by half a pixel with relation to the red and blue gives an effective doubling of the sampling pixels in the luminance channel to over a thousand and results in a 20 per cent improvement in resolution over previous types.

***Below:** Panasonic's field recorder can provide 90 minutes of recording with a standard cassette.*

Most of the high-quality CCDs are specially selected from the consumer production line, thus making them a good example of the consumer product giving rise to the broadcast version. The individual chips are factory fixed on the optical beam splitter to give optimum performance and correct registration. The camera is thus permanently aligned, as the chips do not deteriorate with time and never require replacement.

There are some disadvantages, however. In comparison with high-quality tube cameras, the CCDs can be slightly less sensitive, tend to have somewhat lower resolution and can suffer from background 'noise' that in some circumstances could be detrimental to picture quality. However their dynamic range (i.e. ability to cope with high contrasts in illumination – the sensors are practically immune to damage due to over-exposure, and there is no 'comet-tail'), the low lag, zero geometric distortion, ruggedness, lighter weight and smaller size (14-20 per cent less than comparable tube types) and generally lower running costs (there are no tubes to buy, longer-lasting battery packs due to the lower power con-

***Above:** The new CCD cameras are ideally suited for outside broadcasts and, in particular, news gathering.*

sumption) and freedom from microphony problems, more than compensate. They are ideally suited for outside broadcast use and, in particular, news gathering. In general, they are also fitted with all the automatic set-up facilities found on modern tube cameras such as white balance, black balance, auto iris, selectable video gain, etc.

CCDs, like tube cameras, come in various ranges and prices. There are the out and out broadcast cameras meant for ENG (electronic news gathering) and EFP (electronic field production) use, complete with all possible refinements. These are available from the principal Japanese, American and European companies, though all the CCD chips themselves are produced in Japan. Such cameras, though still costing thousands of pounds, are less than half the cost of a broadcast studio camera.

The major broadcast authorities have codes of practice which set minimum standards of performance. These were particularly necessary at an earlier stage but the quality of picture now produced by most networks is of a very high standard. The quality/cost graph becomes asymptotic however, and a great deal of money can be spent in achieving the last few per cent of picture quality and a lot more in maintaining it. Today, very acceptable pictures for local programming can be obtained from equipment meant for ENG or even industrial use.

The major Japanese companies also market slightly down-market versions of their CCD cameras, which do not meet the Independent Broadcasting Authority (IBA) code of practice. The differences are not necessarily significant, however. Usually it is only parameters such as registration and geometry in the corners which are out of spec. For example, one of the Japanese cameras in the broadcast version has a resolution of 550 television lines, while in the cheaper model this is reduced to 520 lines. The signal to noise ratio is better than 55 dB and the sensitivity gives full output at 1250 lux at f:4 aperture. The price difference, however, is four to one. Typical costs, complete with a suitable lens are, between $28,800 and $31,200 for the broadcast model and $8,000 for the cheaper version.

There are also very cheap CCD cameras available with quite adequate performance in the reproduction of stationary objects. These could readily be used for caption scanners and similar functions. A typical good performance and very small size camera sells at around $2,400.

The choice of video recorder equipment for a broadcasting company also involves some careful thought. It was the demand for a cheap domestic recorder that led to the concept of a combined camera and recorder of lightweight and affordable cost to the general public. This in turn brought about the development of the compact and automatic cameras and the broadcast 'camcorder'.

The type of video recorder (VTR) used can also affect the choice of camera. For example, if the basic recorder is of a U-Matic format there is no point in spending several thousand dollars on a semi-broadcast camera. The recording equipment would not be able to do justice to it. Nor could a camcorder system be used, as the types available are generally not of sufficient quality for broadcast use, nor are they sufficiently portable.

There are exceptions, however, one being the modification technique adopted by Bell and Howell which can provide the equivalent to SP U-Matic performance from a normal high-band U-Matic VTR and camera combination for a fairly low cost – about $800. The modifications are not extensive and do not preclude either the camera or recorder functioning normally as separate units and are totally transparent if a non modified camera is used with the VTR. Dolby C has been used to improve the audio signal to noise ratio by some 18 dB.

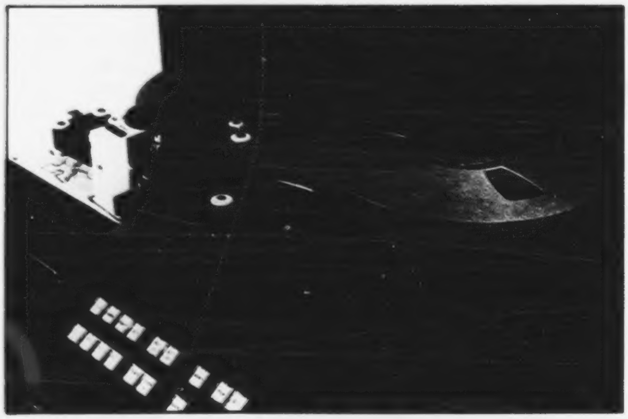
There are camcorders, or camera VTR combinations, available for both CCD and tube camera types. Previously, the usual format has been Betacam, but there are now alternatives, such as a new SP-Betacam, which gives performance equivalent to the international broadcast 1-inch C and B standards, and the M11, also of comparable performance. Both are ½-inch tape systems. The SP-Beta is compatible with previous Betacam systems and can be mixed with the older equipment, though without the improved performance. The M11 is completely new and not compatible with previous M systems.

These are not the only camcorder standards in existence. There are also ¼-inch and ⅛-inch tape standards, some of which are comparatively cheap.

Before adopting any particular standard the broadcasting company concerned must consider the factors involved in interchanging tapes with other companies. ENG recordings are seldom, if ever, interchanged in tape form. This means that such operations can be considered in-house and whatever system most suits the company can be used. This does not apply, however, to exchange or sale of documentary material, for instance, and every transfer generation from one system to another tends to reduce the quality. □

PURCHASING GUIDELINES FOR BROADCASTING EQUIPMENT

The acquisition of new broadcasting products can be a hazardous business when the purchaser has no access to the equipment itself to assess its suitability. In many developing countries, broadcasting engineers have to rely on manufacturers' specifications and simply hope for the best. Simeon Bonzon, Broadcasting Operations Chief at the Bureau of Broadcasts in the Philippines, offers some advice.



Above: *Outside broadcasting units from Ampex being flown out to the recently established television service in Bophuthatswana: major investment of this kind needs meticulous planning and regard to specifications.* **Left:** *All equipment must be assessed for its technical soundness, ergonomic design and clarity of layout. Photo courtesy of Broadcast Television Systems GmbH.*

by Simeon Bonzon

SETTING up or upgrading broadcasting systems equipment to meet both current needs and future requirements needs careful preparation and implementation. Among the priorities to be considered are increased reliability, a sensible approach to modernisation and long-term flexibility.

New technology and increasing competitiveness mean that many broadcasting stations are examining their operations for ways in which to improve their effectiveness and efficiency. In both industrialised and developing nations, broadcasting is important for reasons of economics and trade, politics and diplomacy, including defence.

Typically, the radio and television stations in developing countries in Africa, the Asia-Pacific area and South America are government owned. Alternatively, they are the responsibility of private, civic-religious and educational bodies.

As buyers of equipment in developing nations do not have first-hand access to new products, equipment is usually purchased on the basis of a particular manufacturer's reputation and the specification details provided. The interpretation of the latter is an important responsibility for the engineering staff of any broadcasting station.

Transmitters

According to one American authority, transmitters have 'never been more cost-effective'. New generation transmitters are 'cleaner, more reliable and offer assist circuitry that takes the guesswork out of operating and maintaining them.' However, he goes on to say that it is still the transmitter engineer who is the key to their effectiveness. A combination of super logic and control circuitry will not tune or repair equipment. New developments bring increased reliability, and diagnostic aids are important because they reduce down time. Late generation units have become simpler and more economical because of newer components and advanced circuitry.

Naturally analysis of the product specifications alone is a poor substitute for actually handling the equipment and being able to see whether its design is well thought out. Spacing, location and ease of use mean a lot in terms of operator efficiency. Flexibility is also a major factor, if later expansion is planned.

Serviceability is a further consideration. How accessible is the equipment for maintenance purposes? Better boards spreadeagle conveniently, others are more difficult to service. The frequency response should be flat over the desired range and specifications must be accompanied by an output level tag.

Construction, tube types and operating efficiency all play an important part, but many of these are subject to the purchaser's requirements.

Frequency modulation (FM) specifications are rather complex, especially if a stored generator is used. The unit itself is basically a huge radio frequency amplifier and usually sufficiently broadband for most of the fidelity-determining circuitry to be in the stereo generator and exciter. Right/left separation specifications should include the modulating frequencies and distortion data.

If it is a phase modulation system, the low frequency audio performance should be examined.

It is also worth checking whether the signal-to-noise ratio data was taken with the exciter mounted in the transmitter. The blowers may sometimes mechanically modulate the master oscillator and cause deterioration of an otherwise excellent noise figure. Otherwise, the exciter must be operated in a separate rack, which adds to costs.

Frequency stability of both the main carrier and the pilot is important, and these specifications should be tagged with a temperature range. A transmitter at a remote antenna site may have to operate satisfactorily over quite a temperature degree span.

Studio construction/upgrading

Studio engineering should be versatile and up to date. Affluent broadcasting organisations specialise in sophistication. In developing areas, studios should be amplitude modulation (AM)/ frequency modulation (FM) compatible and, if obsolescence is to be avoided, adaptable for television broadcasting.

Illumination becomes a problem if the studio is to be converted for television. Incandescent lights, preferable to fluorescent lights, are better recessed into the ceiling. And, if affordable, dimmers should be provided.

Almost all pre-recorded programmes today are already heavily audio-processed and limited to around 45 dB dynamic range to fit on the disc/tape. The number of different disc reproducers available may be overwhelming, making actual sampling before purchase essential. The starting motor speed may be of no consequence to a fine music station with a slow, flowing starting speed, for instance, but it will be a curse for rock music.

A popular music station may not encounter a pianissimo in a year, so the low rumble specification will not concern the technicians as much as the starting speed. A good turntable would have a rumble specification of about 40 dB below standard zero level and wow and flutter figures of less than 0.2 per cent. A fast one should reach full speed in a one-tenth turn at most.

Electronic performance of the disc reproducer system is many-faceted. Pick-up and pre-amp should be considered as one system and the manufacturer's specifications analysed accordingly. There is no automatic gain control system between phono cartridge and pre-amp, so the electronics must be able to handle the full dynamic range of the output. Peaks as high as 26 dB above average level on some of the newer records have been observed.

Pre-amp output noise, maximum output and pick-up output voltage must be considered simultaneously to ensure that the system will not be clipping peaks or running unnecessarily close to residual noise level. Output level controls are usually in the out circuits and cannot prevent overload in stages prior to those controls coming into operation.

The usual response and distortion criteria also apply to the disc reproducer. The pre-amp is an equalising device and has much more gain at low frequencies than at the high end. And since response tapering R-C elements are usually at the feedback circuit, there will be less feedback and more distortion at the bass end, unless the open loop gain is high enough to keep the non-linearity down to a negligible level. Performance in this area should be indicated by distortion versus frequency specifications.

Pick-up tracking ability and mechanical tenacity are qualities which in practice often work at cross purposes. A compliant stylus will track well at low pressure but may be too delicate for fast-paced rock music. It may be just right for the fine music station, however.

The tone arm specifications must be compatible with other components. There is little virtue in having a pick-up tracking at ¾ grammes mounted in an arm designed at 1½ grammes or more. Mis-match would result in low mass arm with low compliance pick-up. The low frequency response could actually show a measurable loss due to the stiff stylus causing low frequency mechanical energy to move the entire assembly instead of the internal generating element alone.

Tape systems

As with any equipment, the specifications must be read carefully before a choice is made. For instance, does the signal-to-noise ratio refer to zero level or to two or three per cent total harmonic distortion? The bandwidth measurement must be taken into account. A deck will produce a somewhat lower reading when measured with a 15 kHz cut-off filter as supersonic bias noise is removed.

Distortion may be minimised when the bias is adjusted for optimum performance with tapes. This will, of course, vary a bit from tape to tape, but it can be limiting. Some newer ones boast of distortion as low as 0.5 per cent or less at 1 kHz zero level.

Speed stability specifications are important, especially if operation requires multiple generations. Speed errors can accumulate. Short-term errors, such as wow or flutter, are expressed as per cent, while long-term error is called timing accuracy and can be expressed as per cent or, in an accumulated error, in seconds per unit of time, such as an hour or start-to-end of reel. It may be necessary to make a conversion to seconds of error in order to make a comparison.

Cartridge specifications are similar, except that there are the usual flexibility considerations related to cueing. Like consoles and phonos, they will be subjected to plenty of handling and should be examined mechanically to determine the degree of ruggedness.

Automatic gain control amplifiers/limiters

These are difficult to compare. Some amplifiers separate the audio range into bands and so perform control functions separately on each band, while others employ multiple attack and release time-keyed to the level of incoming signals. Still others use a single attack and single release characteristic. Once the type of control scheme has been selected, the electrical specifications can be analysed.

Distortion figures should be checked to see if data is given for levels below or above the limiting threshold. Some manufacturers give a maximum distortion figure which will not be exceeded at any frequency through the entire range. Naturally, such distortion specifications will not be as impressive as a 1 kHz only figure taken at a low level.

If the limiter amplifier must feed a line, the maximum output level specification should be checked to see if it can drive the line and isolation and/or distribution network losses that may be required.

Telephone systems

Even broadcasting stations in developing countries now use telephone networks in conjunction with their broadcasting operations more and more. The three problems of interface for radio-phone patching are:

☐ caller input level;
☐ studio output quality;
☐ proper levels fed to caller.

Almost all systems rely on hybrids for interfacing. Impedances of circuits within the hybrid must exactly match the phone loop used by the caller. Where a large number of remote callers need to be electrically interconnected at one time, there is an essential procedure to be carried out between hybrid and console. Someone should take the calls and route them to the hybrid; the hybrid itself changes the two-wire circuit into a four-wire one; and, finally, the calls should be processed between hybrid and console. In all instances, systems and personnel must aim to eliminate any annoying extraneous sound and unequal modulation levels.

A fully operational system should be:

☐ noiseless in switching, even when taking a line which may be ringing;
☐ capable of expanding to handle as many lines as necessary;
☐ electrically in the form of two extension phones;
☐ able to conference any trunk with any other regardless of the kind of office the line comes from;
☐ highly reliable with easy access for maintenance;
☐ able to incorporate an 'automatic hold' circuit into incoming lines for periods when no one is on duty to answer calls;
☐ capable of feeding pre-delayed programme to callers waiting in line, at sufficient level so as to cause them to turn their radios down;
☐ fitted with a 'flagging' device to tell the announcer which of the incoming lines he/she has just finished using;
☐ able to eliminate all series circuits with the exception of the telecom company's 'hold' circuit;
☐ equipped with a special delayed-release circuit on the station's exchange so that the caller is automatically disconnected roughly 30 seconds after the call is finished.

Automation

This may sound over-ambitious for broadcasting organisations in developing countries, but the automation of systems can bring numerous benefits to management, such as information on inventory control and sales trends. The degree of automation introduced can vary according to the requirements of the particular organisation. Instead of total automation, for instance, use of a standard procedure to assist a disc jockey is a popular alternative. With human assistance, the operator does not have to cue records, find and stack cards or keep a programme log.

With proper supervision of a system by computer, cassette storage of programmes allows increased flexibility. Recent improvements in audio quality of cassettes makes them a viable alternative to reel-to-reel in most applications. Insertion of local commercials during network feeds may be done on a manual or automated basis.

Maintenance and upgrading

Techniques vary from station to station according to the particular relationship with the manufacturer involved. As new technology increases the complexity of the circuits, it also increases equipment reliability. New products should integrated cost-effectively into existing systems.

Planning should include improvements in production and master control, modifications and updating of the editing room facilities. Despite the advent of new compact, lightweight, high-performance products, most broadcasting organisations appear to be cautious about committing themselves to additional expense on field production. Their focus remains inside the station and on transmitting the best possible quality service. ☐

Checklist

This is a useful seven-point checklist for stations considering the purchase of new equipment:

☐ are stations already using the proposed unit satisfied with its performance? (a customer list should be available from the dealer);
☐ how does the price compare with other similar equipment?
☐ how well-tried is the design?
☐ does it allow for expansion? (consoles may need extra inputs, transmitters could require remote control or a stereo generator)
☐ how much space does it require?
☐ how good will the servicing facilities be?
☐ is the unit compatible with other equipment? ☐

BROADCASTING EQUIPMENT

SONY
SONY
1
Canon

[illegible] ever the past two decades, and [illegible] an alarming [illegible]

The adv[illegible]arge scale integration and very large scal[illegible]ation, allied with the microprocessor [illegible] had a p[illegible]found imp[illegible] on the developm[illegible] of new equipment [illegible] aspects of broad[illegible]ting, particularly [illegible] television prod[illegible]on is concerned. Every single aspect, fr[illegible] camera to recordi[illegible] transmission, h[illegible] been affected to [illegible] degree.

Cameras

Early colour television cameras contained large picture tubes and consumed large

Portability, co[illegible]with high [illegible] are priorities for modern cameras. Sony's BVP-360 is also ideal for use in multicamera systems, with a group of cameras controlled from a single unit.

amounts of power. They were, of necessity, bulky, difficult to handle and required high levels of lighting to provide adequate picture performance. In addition, they required a considerable amount of maintenance and alignment.

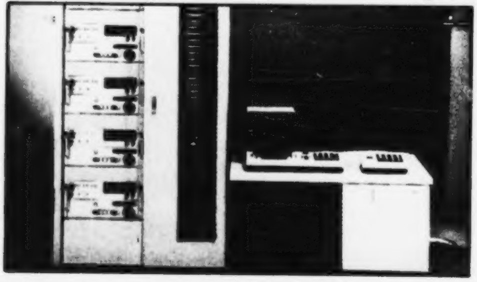
Today's cameras can weigh as little as 29 kg, can easily be carried by one person and are extremely compact. More important than all these factors, however, is their improved performance.

Refinements in the design of camera optical systems have enabled a prism with F1.2 sensitivity to be manufactured. Used in conjunction with an F1.2 lens, the minimum illumination level can be as low as 10 lux.

The ⅔-inch mixed field tubes using either Plumbicons or Saticons embrace all the latest innovations in tube design. Highly controlled deflection of the electron beam is achieved by electrodes deposited directly on to the inner wall of the tube under microprocessor control. Precision focusing is achieved by a coil assembled around the tube. Considerable weight and power saving has resulted from the adoption of mixed field techniques. The reduction in size of optical and mechanical components has been achieved with the use of ⅔-inch tubes.

But it is in the control and set-up of multicamera systems that the state-of-the-art camera really comes into its own. Various automatic set-up functions can be initiated and performed under microprocessor control including registration compensation, centering and colour balance. A comprehensive filing system enables banks of data for reference files, scene files and lens files to be set up and recalled at will.

In the case of a master set-up unit, up to eight cameras can be set up and controlled from a single unit. Using distributed processing, all eight cameras can be aligned simultaneously and virtually perfectly matched. A camera switching unit is under development to enable 32 cameras to be controlled in the same way.

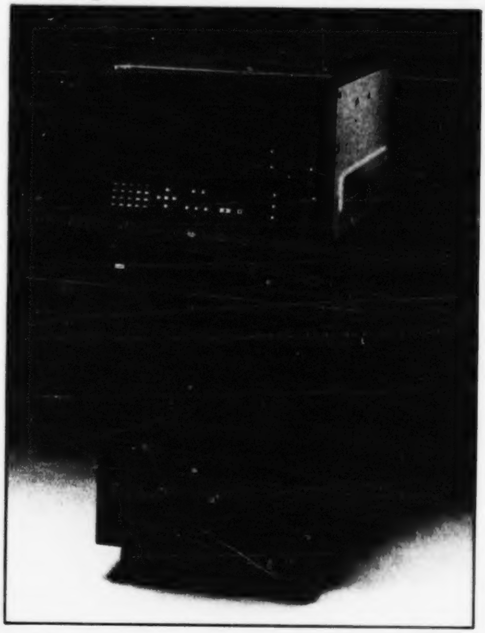


Above: *A cartridge machine capable of handling whole sections of programming can significantly reduce manpower needs.*
Right: *Component digital video recorders, which came on to the market this year, are likely to revolutionise programme editing.*

These developments relate to studio and outside broadcast cameras, but smaller cameras designed for electronic news gathering (ENG) or electronic field production (EFP) purposes have made equally dramatic progress.

Currently arriving on the scene are broadcast quality cameras employing charge coupled devices (CCDs). The advantages of using CCD sensors in place of picture tubes are as follows:

☐ small size,
☐ light weight,
☐ low power consumption,
☐ high sensitivity,
☐ high durability,
☐ freedom from registration adjustments,
☐ resistance to shock and vibration,
☐ no sticking or burning,
☐ no lag.



Electronic news gathering

The first generation of ENG equipment relied almost exclusively on U-Matic recorders connected to hand-held cameras by umbilical cables. This placed inevitable restrictions on the movements of the cameraman.

This disadvantage, allied to the demand for improvements in picture and sound quality, led to the development of smaller, lightweight combined camera/recorders which can be totally operated by one person. The most popular format which emerged was Betacam, originated by Sony but now jointly distributed and soon to be manufactured by Sony, Ampex, Bosch and Thomson. Some 30,000 units of this kind are in use worldwide.

A CCD camera is ideal for integration into camera/recorder combinations. The total weight of such a combination is of the order of nine kilos complete with lens viewfinder and batteries. This represents a saving in weight of some five kilos over earlier separated cameras and recorders.

Video tape recording

Although the Betacam format originated as a news gathering media, the benefit of using this smaller, high-quality format was soon realised and a full range of studio equipment quickly developed.

Dynamic tracking facilities are now available in this format enabling slow motion for sports and other special effects. A spin-off was the development of a cartridge machine holding 40 Betacam cassettes. Continuous replay from these cassettes can be programmed using up to four players. In this way very large portions of the day's programmes can be programmed and a day's series of advertisements can be held, stored and replayed as required.

The technology of Betacart has gone one stage further to produce a machine capable of storing, manipulating and replaying a library of around 1,200 Betacam cassettes.

Despite the fact that the Betacam format is less than five years old, research is continually being carried out to provide further improvements in both sound and picture quality and in cassette durations. Currently, the highest quality picture performance is obtained from one-inch video tape recorders using type C format. Although this format has not changed since its introduction some nine years ago, novel features and facilities are constantly being added.

A major breakthrough occurred some three years ago when a time base corrector small enough to fit into the electronics compartment of the machine was developed. This dramatically reduced the size of consoles required.

A further breakthrough occurred with the development of a machine specifically designed for animation and time lapse recording. The biggest problem in using video for such activities had been the fact that it took some seconds to run the machine up to speed and stabilise it (known as pre-roll). No pre roll is now required for 'delta t' recording, as this technique has become known, and, most importantly, the recording conforms to the stand C format and can be replayed on any C format machine. Animation can thus be reviewed immediately without having to wait for film processing, as had previously been the case. The machine can store up to 200,000 different frames on a two-hour reel of tape.

But, again, it is not only the video techniques which are receiving attention. The latest C format machine not only records excellent quality video but also two high-quality pulse code modulation (PCM) sound channels. The digital information for these channels is recorded in an area of the C format footprint previously allocated for sync recording option. The audio quality has unparalleled dynamic range, signal-to-noise ratio, crosstalk and total harmonic distortion characteristics.

Component digital video recording

In 1986, the world's first practical digital video recorders were demonstrated as pre-production models. The first units will be entering service this year.

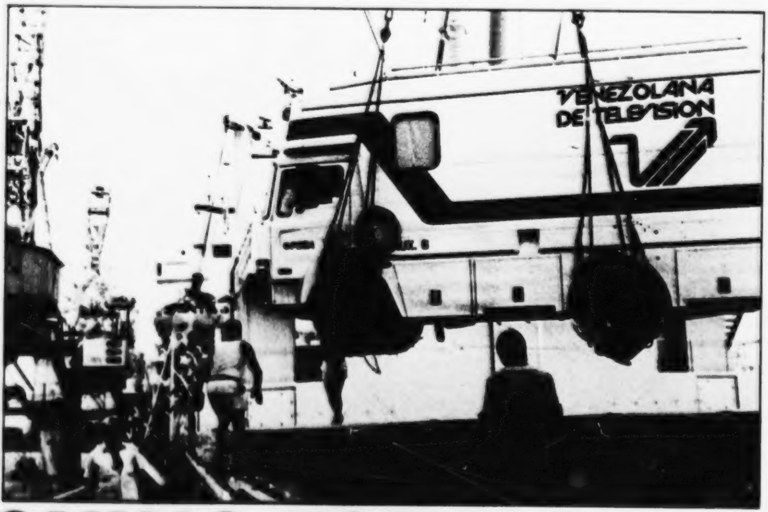
These machines will have a profound impact on the quality of television production in the future and, for the first time, a worldwide standard has been recommended and agreed.

Programme editing has become an extremely sophisticated art and there are very few 'tricks' that the expert is now unable to perform. Special effects can readily be generated, captions added, graphics inserted and so on. In order to achieve a comprehensive programme, tapes often have to be taken through many generations, and in the case of analogue recording, each generation causes some further degradation of the picture quality. This is not so when digital recording is employed, however, and it is almost impossible to see any degradation after 50 passes or generations.

Sophisticated processing can thus be implemented without danger of severe degradation. These digital video tape recorders use signals in three components Y, R-Y, B-Y and the sampling rates are 13.5 MHz for luminance Y, and 6.75 MHz for the two colour component signals. Recordings are made on 19mm tape cassettes with duration of up to 76 minutes.

Conclusion

Digital techniques have now been employed in the television environment for some years and there are very few items of equipment which do not employ at least one microprocessor or digital circuit. It is certain that their use will continue to grow with consequent improvement in quality, a greater range of sophisticated features and improved reliability. ☐



***Right:** The successful design of an outside broadcasting unit requires constant discussion between manufacturer and customer, especially if the vehicle is to be sent to a distant destination.*

DESIGNING FOR OUTSIDE BROADCASTS

by Stuart N Moorse

Outside broadcasting facilities play a major role in the broadcasting services of most developing countries in providing relevant and varied programming to their audiences. As with studio equipment, their planning and design requires considerable attention to detail. Stuart N Moorse, of the Technical Sales Department of PESA International Ltd, outlines the planning priorities for outside broadcasting and other mobile units.

THE planning design and manufacture of modern television outside broadcasting (OB) units requires the solving of a diverse range of problems that would be quickly handed to the appropriate sub-contractor if the project were a studio installation. With the possible exception of air-conditioning, these now have to be satisfactorily overcome by the design team of the OB unit manufacturer in order to satisfy the requirements of the customer. Similar problems, and their solutions, are also encountered to varying degrees with central mobile control units (as used for multi-vehicle productions), radio production units, lighting control vehicles, links vehicles, back-up units and mobile transmitter and studio units.

The adoption of new standards in broadcast engineering, particularly in the area of video tape recording, has resulted in a change in both the content and the role of OB units, both large and small. The introduction of electronic news gathering (ENG) facilities around the world has resulted in small mobile units being required by the majority of broadcasters. These are mainly adaptations of station wagons or small standard vans from vehicle manufacturers, designed to permit rapid deployment for the coverage of important news stories. At the other end of the scale, a growing number of customers are employing large mobile production vehicles. These are based on an articulated trailer design or on a multi-axle rigid chassis and incorporates sophisticated facilities throughout, including multi-VTR editing and multi-track audio recording systems.

Initial planning

Once the need for a new OB unit has been established, and the necessary budget approved, the specifications for the unit require much cooperation and planning on the part of the customer's programme and engineering departments.

***Above:** The choice of chassis depends upon the loading requirements, the local availability of spare parts and service facilities and the local road regulations.*

The usual starting-point is to determine what equipment is to be contained in the vehicle. This will largely be determined by the type of programmes to be made, or events to be covered. Once this has been established, the overall technical facilities can be discussed and agreed, together with the quantities and types (and perhaps even the manufacturer and model number) of the major items of equipment. Typically the following would be scheduled:

- ☐ quantity and type of camera channels: studio or portable (or mixture);
- ☐ size of vision mixer: number of inputs, number of mix/effects busses, possible incorporation of digital effects, etc.;
- ☐ size of audio mixing unit: number of inputs, number of groups, etc.;
- ☐ quantity and type of VTRs: 1-inch B or C format, U-Matic (or mixture), editing facilities, etc.;
- ☐ additional video sources: character generator, still store, caption scanner, etc.;
- ☐ additional audio sources: audio tape recorder, cartridge machine, turntable, etc.;
- ☐ power facilities required: trailer generator, etc.;
- ☐ microwave link facilities (if required).

The final consideration in the initial process is the interface of the technical hardware and system to the operational philosophy of the customer and the need for the unit to provide satisfactory working conditions for the staff. This exercise will provide a broad outline for the lay-out of the unit and the overall dimensions involved.

Specifying the OB unit

The task of taking these overall requirements and from them compiling the specifications for the required unit now becomes the responsibility of the customer's engineering department.

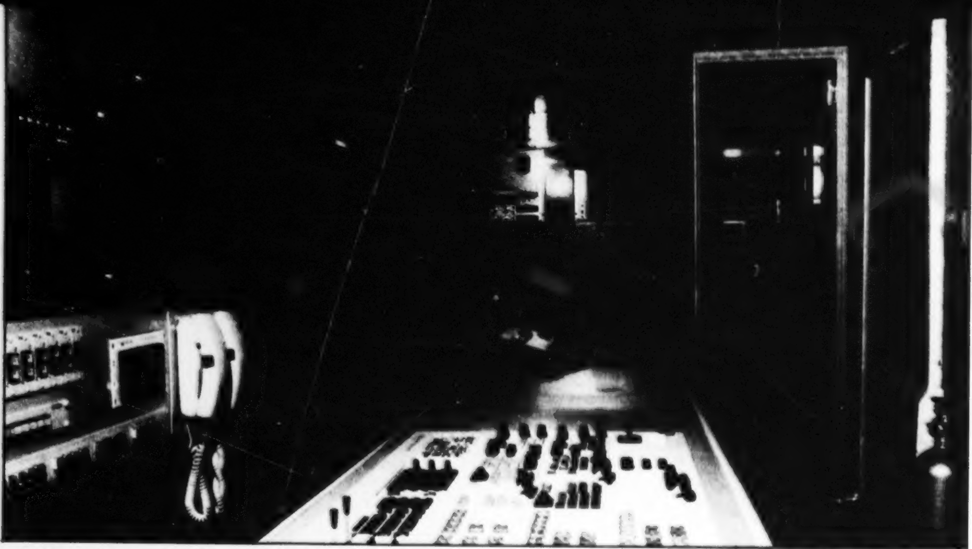
One of the earliest decisions to be made is the type of vehicle on which the OB unit is to be based. In general the choice will be in favour of a self-propelled 'composite' vehicle, although trailers, containers and the 'dual vehicle' configuration all have their merits in relation to particular applications. The final decision can only be made after detailed consideration of the facilities to be contained in the unit, together with the local conditions and regulations under which it will be required to operate and, of course, the budget allocated for the project.

The level of detail included in these specifications varies widely. Some customers specify their requirements in extreme detail, leaving the manufacturer little or no opportunity to propose alternative (and perhaps cheaper) solutions. Conversely some customers make their specifications in broad outlines only, and draw on the experience of manufacturers to suggest the most cost-effective options.

Once the specifications of the unit have been completed they are usually formally issued to selected OB manufacturers as part of an 'Invitation to Tender' document.

Design and construction

When the contract has been awarded, the responsibility for the detailed design and construction of the unit passes to the selected manufacturer. There are a number of major areas that must be taken into consideration by the manufacturer during the design of the unit



***Above:** The interior design has to take into account air-conditioning, thermal and acoustic insulation and, above all, comfortable working conditions for the broadcast technicians.*

which will probably affect the final design adopted.

Chassis

The choice of chassis is influenced by three main factors:

☐ loading requirements of the final unit design;
☐ local availability of spares and service facilities;
☐ local road regulations.

In general terms the final decision is arrived at by consideration of the foregoing, with due account being taken of the customer's existing OB fleet.

Vehicle body

The final lay-out adopted for any OB unit is usually a compromise between the technical requirements and operational practices of the customer and the physical limitations imposed by the vehicle. Because of these three conflicting factors it is first necessary to finalise the technical facilities, together with the associated power distribution system and vehicle services. The air-conditioning requirements can then be calculated and the necessary system designed. Only then can the overall vehicle design be finalised and the weight distribution of the unit accurately calculated.

The amount of data involved in these calculations is considerable and the assistance of a computer is usually enlisted. This is essential should it become necessary to reposition items or vary the lay-out during the detailed design of the unit. It is at this stage of a project that it may be necessary for a customer to modify his requirements due to restrictions on the size of vehicles, axle loadings, etc., imposed by the transport authorities in the country concerned, or due to the limitations of the chosen chassis.

To achieve the best results from the staff operating in OB units it is essential that the environment in which they are required to operate is comfortable. The internal conditions, for instance, must be as stable as possible. To this end the external walls of the body are normally constructed of a 'sandwich' of materials, consisting of a fibre-glass or aluminium outer shell, treated plywood covered with carpet on the inside and a 'filler' of polyurethane foam. In addition to producing an efficient thermal insulation, this construction has the advantage of having good acoustic insultation properties.

The high operational cost of location work, together with the unique nature of many of the events covered by OB units, demand that any down time is reduced to an absolute minimum. Therefore the design of the interior of the unit should place particular emphasis on operator comfort and ergonomics together with ease of servicing and replacement of faulty equipment.

Another important requirement to be taken into account is the provision of space for the storage of items required when operating in the field. This includes camera heads, tripods and skids, lenses, microwave link antennae, commentators' equipment and cables of all types. All of this equipment is used outside the unit and, wherever possible, it should be kept out of the operational areas to minimise the introduction of dirt and dust. Storage areas are, therefore, required around the outside of the unit to house as many of these items as possible, with additional cupboards located inside the unit for small items such as microphones, headsets, equipment hand-books, reels of tape, etc. For complex location work one or more back-up vehicles may be required to accompany the unit to carry the peripheral items.

The construction of the body of OB units is normally sub-contracted to a specialist vehicle bodybuilding company which works to the designs and specifications produced by the OB manufacturer's design team. The fitting out and finishing of the interior of the body is probably best carried out at the manufacturer's factory, during the installation of the equipment, thus reducing the overall delivery time of the completed unit.

Air conditioning

The final design of the air-conditioning system has to take many factors into consideration. These include the lay-out of the unit, the heat dissipation of the operating equipment, the number of persons on board and the insulation properties of the vehicle body together with the climatic conditions and altitude at which it is required to operate.

Most OB manufacturers collaborate with a specialist air-conditioning company to overcome the problems encountered in the design and installation of the air-conditioning systems. The final overall system adopted is necessarily complex since the installation that it is to serve is complex and the conditions affecting its operation are extremely varied.

The air-conditioning units employed usually contain heating elements which can be used to warm the air within the unit when required. For units that are to operate in very cold climates a separate oil-fired warm-air heating system will be required. This system allows the interior of the unit and the equipment to be kept warm when not in use on location, thus alleviating problems arising from condensation, reducing 'warm-up' time and any resultant drifts in its performance.

A separate air-conditioning unit, driven from the vehicle engine, can be installed in the driver's cab to provide comfortable conditions for the occupants while the vehicle is on the move.

Power facilities

While power facilities incorporated in modern OB units are sophisticated, they are also reasonably standard. Probably the most important consideration is the power regulations in force in the country of destination. These can differ widely and in some countries are extremely onerous. It is important that both the customer and the manufacturer are fully aware of the requirements in this area.

Location work often requires a power generating set to accompany the OB unit. This can be housed within the unit, placed on resilient mountings, trailer-mounted for towing behind the unit or it may form part of the back-up facilities. The first two require the set to be housed in a sophisticated sound-proofed enclosure. This must be designed to provide sufficient attenuation to reduce the noise produced by the generating set and its associated exhaust system to an acceptable level to allow it to be used in the close proximity of either the unit or the scene on location. In addition, the design must take into consideration the climatic conditions and altitude at which the generating set is to operate. If required, the generating set can have sufficient additional capacity to supply other services required on location including, perhaps, a limited amount of scene lighting.

Other considerations

The foregoing can only be taken as a brief resumé of the major areas of consideration and is certainly not meant to be exhaustive. Further subjects that must also be considered include:

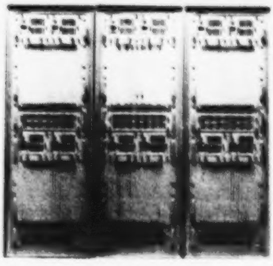
☐ communications facilities, including the interfacing of any radio or line telephone systems;
☐ overall system and individual equipment specifications;
☐ test facilities and procedures;
☐ accessories (e.g. camera mountings, microphones and stands, cables, commentators equipment, etc.);
☐ spare parts;
☐ training (maintenance and operational);
☐ local safety laws, working practices and other applicable regulations.

All of these form an important part in the successful planning and design of a modern outside broadcasting unit. Naturally another dimension is added when the consideration of the technical facilities is included in the process outlined above, especially as the two subjects are inter-related in the final design of the unit.

For the successful execution of any OB project, it is essential that the customer has clearly defined his requirements and the nominated manufacturer fully understands them. Without doubt this is best obtained by establishing a close working relationship between the staffs of the customer and the manufacturer at the outset. It is also important that the manufacturer keeps the customers' staff fully informed and, if appropriate, involved in the major design stages of the project. ☐

Christian Rovsing, a member of ALCATEL NV. the second largest telecommunications group in the world, supplies military communications systems for

● Automatic Message Handling Systems (CR-AMS) ● Strategic & Tactical Networks



The CR80 Computer

The defense systems are implemented on the company's CR80 fault-tolerant computer, ensuring very high system availability, redundancy and survivability. The extensive *modularity* of the CR80 computer provides the customer with systems, which never become obsolete. *Expansion* from very small systems with a single CPU into very large systems containing more than 2000 CPU's and thousands of access lines is achieved merely by adding hardware modules and standard software to existing systems with no or very short disruption of operation.

Automatic Message Handling System (CR-AMS)

CR-AMS provides military customers with extremely reliable message handling facilities, using the military *ACP-127 message format* implemented by most nations in the Western world.
The message format has been adapted to the automated data processing environment and *requires no skilled signals personnel* to use.

The CR-AMS provides:

- Interactive dialogue between user terminals and computer
- Automated message handling
- Automatic Distribution
- Private data base for each terminal
- Global storage and logging of all traffic
- Multilevel security
- Dual password scheme
- Six message priority levels

Additional features

- Interfaces to public data nets
- Positive acknowledgement of message delivery
- Supervision and control
- Encryption
- Remote diagnostics

AMS systems are built to customer specifications. Complete systems are integrated and acceptance tested at the factory before installation in the field.

Site Support

Experienced engineers perform site support. Encrypted remote diagnostic dial-up links between customer sites and the factory will be established.
Diagnostic of faults and repair can be performed *without disrupting normal operation* of the system.

Training

Customer Personnel of all skill levels will be trained in maintenance and operation of the system.

For more information please contact

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Circuit Research Labs, known internationally as CRL SYSTEMS, specializes in manufacturing quality audio devices which modify broadcast audio signals before transmission into forms which achieve MAXIMUM TRANSMISSION COVERAGE and HIGH AUDIO QUALITY.

When used properly, these products can extend transmissions up to 2 to 3 times over those which do not use such products.

MEDIUM AND SHORT WAVE MONAURAL AUDIO SIGNAL PROCESSING. CRL provides two systems designed for monaural Amplitude Modulation transmissions.

For simplicity, the economical CRL AM-2 system provides reliable and low maintenance installations. It can be made into the larger system below by adding an additional unit. This system contains the model AGC-400 Audio input Gain Controller and the model PMC-400A final Peak Modulation limit Controller.

The larger CRL AM-4 system, provides the maximum transmission signal coverage capability while maintaining the best audio quality. This system contains the above units and an additional model SEC-400 four band audio compressor.

The AGC-400 provides high quality audio signals by increasing low input audio levels and by decreasing excessive audio levels that usually occur in original program signals.

The SEC-400 in the larger system is used to provide maximum reception coverage by separating the audio signal into individual bands and controlling each band. This allows the user to modify the transmitted audio tonal quality for best received signal fidelity and to gain additional audio loudness depending on user preference.

The PMC-400A provides the final interface to the actual transmitter. It provides instantaneous control of audio peaks, transmitter modulation compensation, transmission bandwidth control and transmitter over modulation prevention. This device can provide up to 3 dB of improvement over similar devices when used on plate and screen modulated transmitters because of its built-in compensators.

AM MEDIUM WAVE STEREOPHONIC AUDIO SIGNAL PROCESSING. AM stereo transmissions (such as Motorola C-QUAM®) require a different form of audio control as compared to recording studios or FM stereo transmissions. This is because AM stereo is basically transmitted as the addition and subtraction of the stereo audio channels. Final transmission control must therefore be in these forms and NOT as stereo signals.

CRL offers the AM-2S system which provides reliable and low maintenance installations. This system can be made into the larger system below by adding an additional stereo unit. The AM-2S consists of the model SGC-800 audio input Stereo Gain Controller and the model SMP-900A final limiting AM Stereo Matrix Processor.

CRL's larger AM-4S system provides maximum transmission signal coverage and control while maintaining high stereo quality. This system contains the above units and a special stereo four band audio compressor, model SEC-800.

The SGC-800 and SEC-800 in these systems are stereo versions of the above monaural units.

The SMP-900A provides final modulation control for AM stereo transmission and the requirements described previously. Proper control is provided by transforming the stereo audio signals into sum and difference signals. This unit provides absolute audio peak control, transmission bandwidth control and final stereo transmission over modulation prevention. Stereophonic enhancement of transmitted signals produces greater received stereo separation effects.

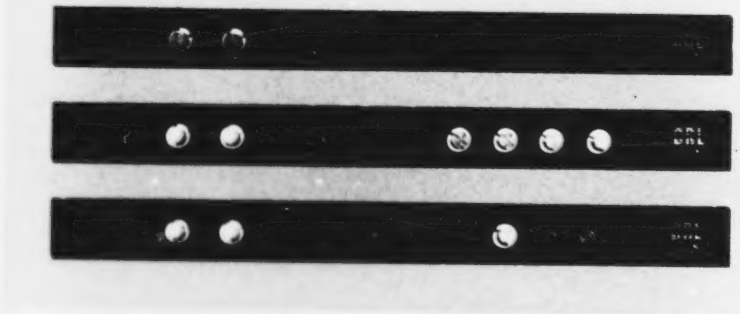
FM STEREOPHONIC ENCODING AND AUDIO SIGNAL PROCESSING. The CRL model SG-800A DIGITALLY synthesized stereophonic encoder transforms stereo audio signals into the standard FM stereo broadcast signal. This unit offers among the highest performance in the world at very low cost.

For FM stereo signal processing, CRL offers two systems which include the above SGC-800 Stereo Gain Controller, the optional four band SEC-800 compressor and a revolutionary FM final limiting device, model SMP-850. This device offers absolute FM over modulation control and superior stereophonic sound capability. As a main feature, it includes a unique stereophonic sound field expansion system which intelligently increases received stereo separation of FM broadcasts.

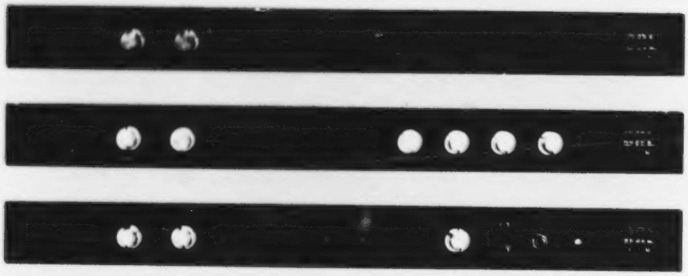
Audio and low speed data channels can be added to FM transmissions with the CRL SCA-300B SCA broadcast encoder. This device has a unique digital AFC which allows its operation to be programmed from 54kHz to 102kHz and also includes input audio program limiting.

POST RECORDING AUDIO NOISE REDUCTION SYSTEMS. Used world wide, CRL offers stand alone audio noise reduction systems, models DX-1 and DX-2 using CRL's exclusive Dynafex® noise reduction integrated circuits. These devices can provide up to 30 db of noise reduction on existing noisy audio program sources.

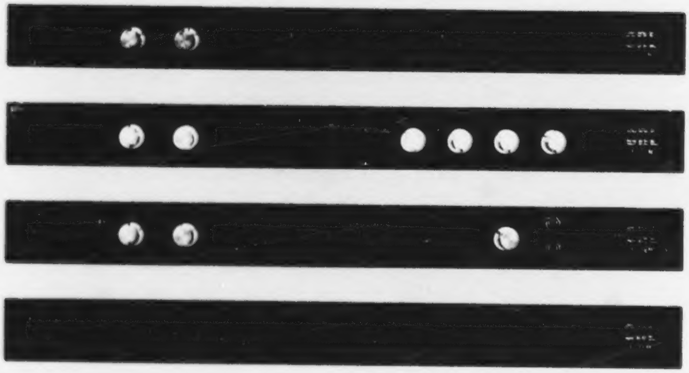
Recording and Radio Transmission Audio Control Devices



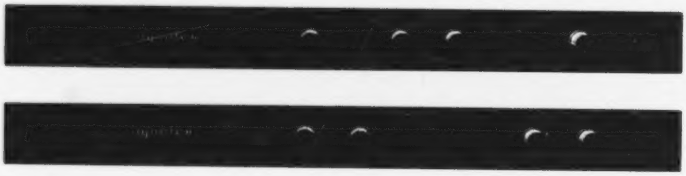
Medium and Short Wave Monaural Audio Signal Processing



AM Medium Wave Stereophonic Audio Signal Processing



FM Stereophonic Encoding and Audio Signal Processing



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ANTENNAS AND TOWERS

'Out of sight, out of mind' is an apt description of many user's attitudes to towers and antennas. At ADC we strive to ensure that the reliability of our total packages justifies that attitude.

As with many things, long term satisfaction with a transmission system relies on good planning as well as on implementation. Often we find however that whilst much care has clearly been put into preparing specifications for studios, programme input equipment and transmitters, unless a specialist consultant has been involved the choice of towers, antennas and associated items is little more than an afterthought. This is unfortunate as correct selection of these integral links in the chain helps to ensure overall technical performance as well as provide immediate and long term economic advantages.

Whatever the purpose of an installation, whether it is for a point to point microwave link, radio or television broadcasting or any other form of communication, there are several necessary features in common. These may be summarised under the heading 'efficiency of energy transfer' and divided into two main areas.

(a) The transfer of energy from the transmitter to the antenna with minimum loss and distortion.

(b) Radiation of this energy to required receiving sites in a manner ensuring that sufficient field strength is obtained where wanted whilst possibly at the same time protecting other areas.

Consideration of the first of these divisions covers switching frames, combining units, filters and transmission lines. Telephone links have carried many channels of information for a long time but in many parts of the world the economic and technical advantages of shared systems for multi-channel radio and television broadcasting are only now being recognised. In the United Kingdom shared facilities have been used by the BBC and the IBA for many years thus enabling ADC engineers to build an enviable fund of expertise in this area. With increasing use of the rf spectrum the spacing between operating frequencies has continually decreased and combining unit and filter design has had to keep pace in order to provide higher isolation and intermodulation suppression whilst maintaining stable low distortion transmission. This is particularly true for FM radio broadcasting.

Transmission lines are expensive and must be carefully selected to optimise cost, low loss and power handling safety factors under the prevailing climatic conditions. Lines must be carefully matched to both transmitter and antenna with minimum discontinuities to ensure distortion free handling of television signals and other high speed data services.

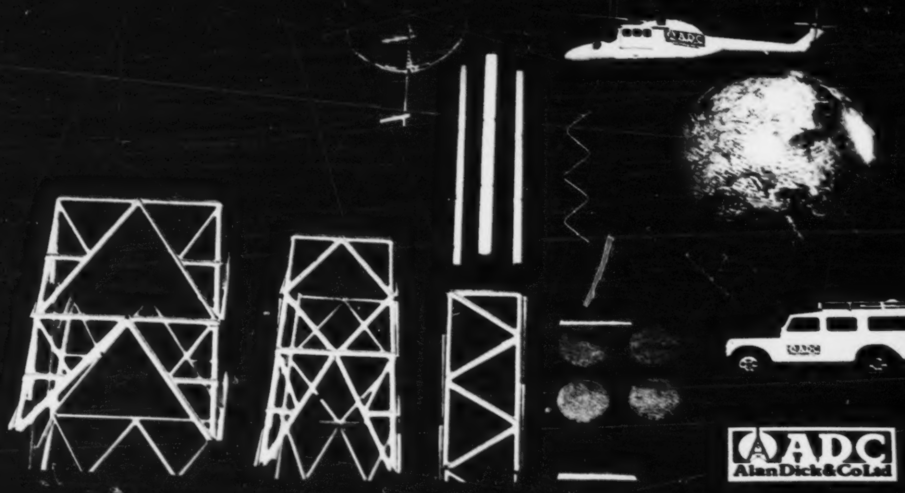
With regard to radiation patterns and gain, a wide range of antennas is supplied by ADC in all the broadcast frequency bands. The advantages of carefully tailoring patterns to the required service area are many. National boundaries may be protected, reflections from hills reduced, co-channel services more closely spaced and above all the radiated energy may be concentrated in the required service area. The latter will reduce wasted transmitter power and contribute to the ongoing economic operation of any individual system or network.

If antennas are easily forgotten, the guyed masts or self supporting towers carrying them are often relegated even further. This is very short sighted. In MF broadcasting the structure may also be the radiating element, but in all systems the integrated design of towers and antennas pays large dividends. The advantages of high gain antennas with narrow beams cannot be realised using poorly designed towers which twist and bend excessively. The reliability of long distance links depends heavily on tower stability.

Modern computer aided design and use of special grades of steel enable very stable structures to be custom built economically to support the largest multiple antenna arrays or a few small Yagis. Any intending tower owner would however be well advised to consider specifying additional load carrying capacity to enable expansion of his own services and possible rental of space to others.

Attention to all these aspects plus many other details such as specialised foundation design, tower lighting, antenna monitoring and comprehensive maintenance programs are ADC's contribution to 'Developing World Communications'.

We supply the equipment and make it work for you!



Now you can choose one company to Design, Manufacture, Transport, Construct and Commission your communications structures and broadcast antennas anywhere in the world!

The company is ADC.

With worldwide expertise in the development and production of broadcast and communications towers and antennas, we have built up an enviable reputation as the No.1 company.

The design and manufacture of associated items such as multi-channel antennas, transmitter combining units and a wide range of transmission line equipment allows us to keep up the pace of technology.

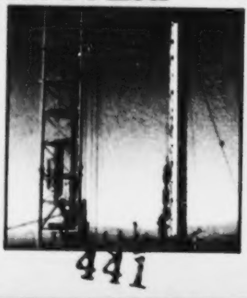
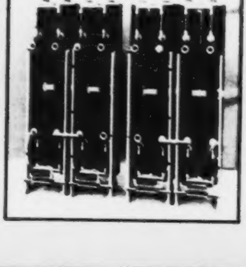
Constant research and development, combined with efficient production and quality control in ADC's own facilities, ensure that we continue to communicate from the top.

ADC – Communicate with the experts.

Alan Dick & Company Limited
The Barlands, London Road
Cheltenham GL52 6UT, England
Telephone: (0242) 518500
Telex: 43534 Fax: (0242) 510191

ADC
Alan Dick & Co Ltd

Associated companies:
Alan Dick (Canada) Inc;
Alan Dick & Co (Nigeria) Ltd;
Al Bawardi Alan Dick, UAE;
LDL Communications Inc, USA.

NYTONE VIDEO SLIDE SCANNER SYSTEM

The Video Slide Scanner System produces broadcast quality color signals derived from 2" x 2" film transparencies. The Model VSS-1 uses a standard carousel slide changer assembly and the Model VSS-2 use a random access changer assembly. All models have an 80-slide capacity tray that will accept standard or glass mounted 35mm slides. A special single gun Cathode Ray Tube produces a flying spot light source that scans the film material. After being separated into red, green, and blue components by special dichroic filters, the light source is introduced to color selected photomultiplier tubes, amplified, gamma corrected and processed by an IQ internal color encoder. The video signals are automatically controlled to give constant output signals in relation to variable density of slides. The resulting video signal is compatible with all broadcast applications and wherever high quality slide-generated video is required (media presentations, teleconferencing, slide transfer to video tape, video projection).

The Video Slide Scanner CATHODE RAY TUBE is coated with rare earth phosphors to reduce spot retention and enhance spectral response. To increase the life of the CRT, a special non-burning face plate is used to give increased life to the scanner CRT.

The system incorporates high efficiency optics and photomultiplier tubes which allow the CRT to operate at a relatively low beam current.

The slide changer assembly for the VSS-1 allows the slide material to be indexed manually by a top panel mounted control or by optional remote control. Remote control allows for forward and reverse indexing and also has a CRT standby switch. The changer mechanism also includes an optical focus adjustment. The VSS-2 changer assemblies have servo motors and modifications that will allow use of random access capability. Random access is keyset controlled.

All VSS models can be driven internally or externally to interface with virtually every production application. The system includes as standard features an internal IQ (NTSC) color encoder, RGB output, sync generator, colorbar generator, and various potentiometer type adjustment capabilities. All circuitry is easily accessible. If failure of any circuit occurs, it is simply removed and repaired or replaced. Diagnosis of problems, in most cases, is done over the phone with Nytone's factory service personnel. Replacement parts can be shipped immediately via overnight carrier, minimizing down-time.

Dimensions of the Scanner unit are 14" high x 19" wide x 20" deep. Sliderails are included for standard 19" rack mounts.

Units can also be ordered with side panels for table top operation.

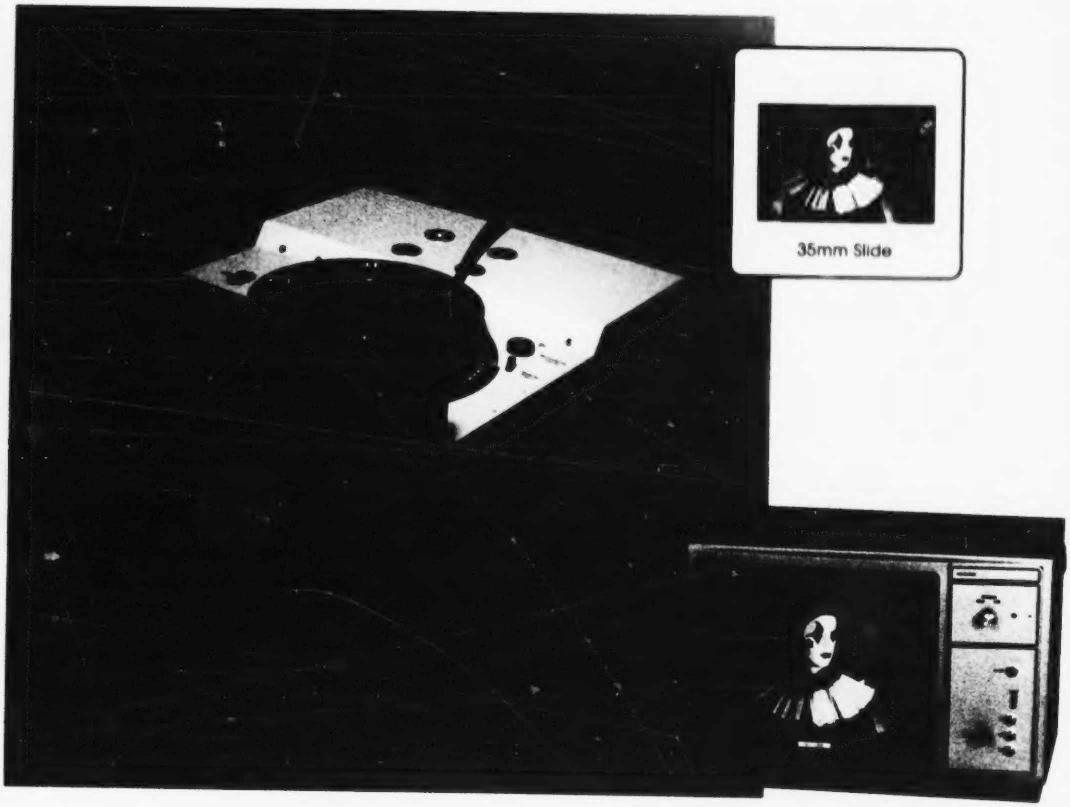
For further information contact:

NYTONE ELECTRONICS
A Division of Nytone Inc.
2424 South 900 West • Salt Lake City, Utah 84119, U.S.A.
Telephone: (801) 973-4090

NYTONE

VIDEO SLIDE SCANNER SYSTEM

An economical photographic slide to video signal system



Models VSS-1, VSS-2

VSS-1 SEQUENTIAL COLOR SLIDE SCANNER SYSTEM complete with tray, test slides, power cord, slide rails and extender card.

VSS-2 RANDOM ACCESS COLOR SLIDE SCANNER SYSTEM complete with micro-processor slide control, digital remote control Box RA-2, tray, test slides, power cord, slide rails and extender card.

- Broadcast Quality Color Slide Reproduction
- 80 Slide Capacity
- Colorbar generator
- Self Contained – Stand Alone Operation
- Video A.G.C.
- GenLock
- 450 to 750 Line Resolution

NYTONE ELECTRONICS
A Division of Nytone Inc.
2424 South 900 West • Salt Lake City, Utah 84119, U.S.A.
Telephone: (801) 973-4090

Professionals around the world use Sennheiser microphones and cordless transmitters and receivers in the studio and on the stage. And for good reason.

Before it goes on the market every one of these high-quality products is subjected to careful testing under typical practical conditions. And every individual unit must pass a stringent quality control inspection prior to shipping.

The soloist, speaker, sound technician, director and orchestra, all know: microphones, transmitters and receivers are given a thorough shakedown before leaving the factory. That's your guarantee of satisfaction.

Quality means lifetime dependability. Professional expectations demand top quality.

SENNHEISER

The choice of the professionals

Sennheiser. These products are unequivocally identified by the logo and their unmistakeable design. And by their performance capabilities.

Professor Fritz Sennheiser founded this high-tech company on June 1, 1945. "Labor W" stood for the "Wennebostel Laboratory". A tiny community near the trade-fair city of Hanover in northern Germany lent its name to a new firm soon to be known 'round the world.

A new name – Sennheiser electronic – signalled to the world the expansion of a company which started by developing and manufacturing microphones and vacuum tube voltmeters and built its reputation on this basis.

Today almost 1500 people are at work for Sennheiser: in research and development, in manufacturing and for worldwide distribution and in a service network that spans the globe.

Renowned manufacturers around the world fill their needs for integrated microphone capsules, dictating microphones, stereo headphones or cordless transmission systems together with all the associated components and devices by making use of the developments and products of Sennheiser electronic.

The professional spectrum including radio, television, cinema and the stage, and users of cordless remote data transmission and topend home entertainment electronics all make Sennheiser products their first choice.

Quality and economy are the result of intensive research and development work, complemented by extensive know-how in manufacturing technology which many competitors have sought to emulate.

WE DO MORE THAN
MERELY SOLVE YOUR PROBLEMS

Sennheiser offers solutions to your problems with sophisticated technology and a wide range of products.
But Sennheiser offers even more – top-quality service and continuous product improvement.
Sennheiser products: built by professionals – for professionals:

- * Studio condenser microphones
- * Dynamic microphones
- * Lavalier condenser microphones
- * Cordless microphone systems 30 – 950 MHz, up to 100 channels at the same time.

For detailed information and the name of your local dealer please write to:
Sennheiser electronic KG, 3002 Wedemark,
Tel.: 05130/583-0.

SENNHEISER

LeBLANC
DEDICATED TO COMMUNICATIONS!

The LeBLANC story began in 1962 when two partners established a company, LeBlanc & Royle Telcom Inc., to design and build communications towers in Oakville, just West of Toronto, in Canada. This was a busy period in Canadian communications history. A new private television network was being established and the telecommunications industry was expanding rapidly. It was a good time to build a company dedicated to quality and performance.

LeBlanc & Royle prospered and grew, and after ten years the original partners sold the company to its employees whose dedication and resourcefulness had brought it so much success. By then new opportunities were appearing in other areas of the world and the company decided to expand into the international marketplace.

During the seventies and eighties LeBLANC developed or acquired several additional companies serving the communications industry. The group has now supplied products and services to more than fifty countries internationally.

A dedicated International Division has now been established. This new division has a team of highly experienced personnel who will concentrate initially in expanding services for the Middle East, Africa and the Pacific Rim areas in particular. As part of the Head Office in Oakville, the Division employs the substantial resources of group companies to answer the needs of its clients. These include the services of the company's professional engineers in preparing custom computer designs for structures and equipment to meet customer specifications.

In order to complement its own range of products and services LeBLANC will employ the products and services of outside suppliers, who are capable of meeting the company's quality criteria. And, whenever a client needs help in the procurement process, the International Division also acts as a consulting and purchasing source for products required to complete a turnkey project. The company's many years of experience in dealing with international manufacturers can save customers considerable time and expense in this area.

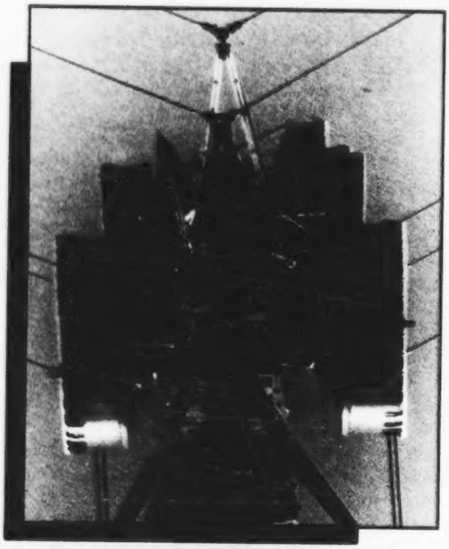
LeBLANC's activities now span almost every conceivable aspect of broadcast and telecommunications operations including the design, manufacture, construction, testing, and servicing of all types of related equipment. The group includes leading international names in the production of radio and television transmitters, combiners, switchers, antenna systems, point-to-multipoint microwave systems, equipment shelters and of course towers and guyed masts up to 700 metres high. In fact LeBLANC is capable of providing a complete service, from original drawings to a working product, using its own in-house resources. LeBLANC even has a broadcasting and cable subsidiary, Norcom Telecommunications Ltd., providing first-hand operating experience through which it has gained a better understanding of customers' needs.

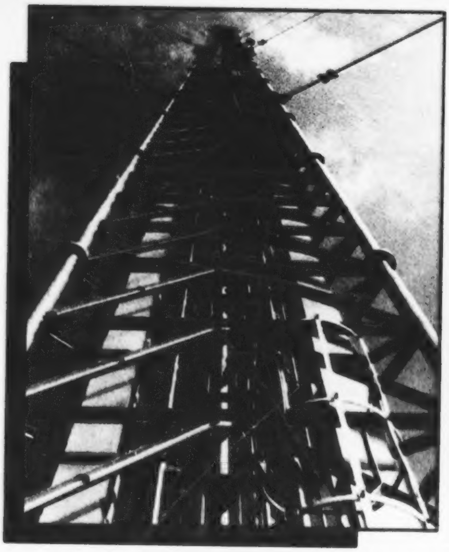
LeBLANC's service does not end with the commissioning of a new transmission system. The International Division also undertakes training and technology transfer to help overseas customers maintain their equipment in good order and to help them develop local manufacturing facilities to support their newly acquired technology.

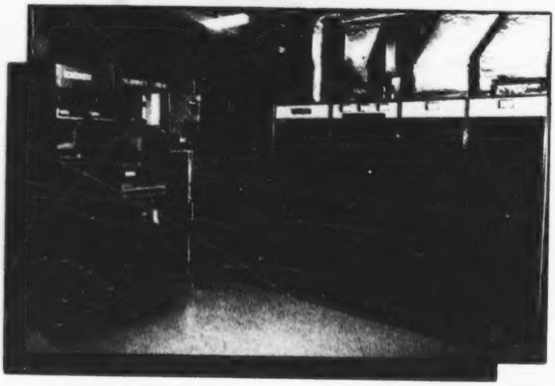
In addition LeBLANC maintains numerous service teams to assist with emergencies and to supplement the capabilities of client engineering departments. Individualized custom contracts can be arranged to fill these needs.

LeBLANC is a dynamic and energetic organization. Over the past fifteen years it has demonstrated an ability to grow at an annual compound rate in excess of 30%. This significant success is a direct reflection of the degree of customer satisfaction the company enjoys. It points to even greater successes as the company becomes recognized in new markets around the world.

Communications Systems and Broadcast Transmitting Stations for the entire World!







LeBlanc communications group companies have established an enviable reputation in more than fifty different countries for quality and reliability in the design, construction and servicing of transmission equipment for broadcasting and telecommunications.

LeBlanc is a world leader in the provision of towers, up to 700 metres high, broadcast transmitters, antennas and combiners, switchers, and microwave systems, to suit all types of terrain and climatic conditions. We also test and service these systems, and construct civil works and support facilities.

Please write for further details and literature if you need any of these products and services:

- Turnkey transmission and microwave systems
- Communication towers and guyed masts up to 700 metres
- Antenna, combiner and switcher systems
- Site construction and shelters for transmission equipment
- Earthing/grounding systems.
- Maintenance of towers and antenna systems

LeBLANC

LeBLANC & ROYLE TELCOM INC.
International Marketing Dept.
514 Chartwell Road, Oakville, Ontario Canada L6J 5C5.
Tel: (416)844-1242. FAX: (416)844-8837. TLX: 06-982226.

THE TIFFEN MANUFACTURING CORPORATION

First Name in Quality Filters

THERE are only two words needed to sum up the success of the Tiffen Manufacturing Corporation — **Quality Filters**.

It is these two words that are so often used to identify the company that supplies photographic filters and lens accessories to more than 30 major countries throughout the world. It is also these two words that camera people in the motion picture, television, and still photography industries have come to rely on for achieving the best results.

Tiffen Filters

Tiffen is the world's leading supplier of photographic filters and next year will be celebrating its Golden Anniversary. Professionals rank Tiffen number one in innovation. Many Oscar-winning films can attest to this because it was Tiffen Filters that assisted in the production of accurate colour balancing and special effects.

Two filters in particular that have attracted much attention in the film industry are the fog effect and softnets, which are primarily used to soften a scene or create a mood. Tiffen supplies them in a range of densities, enabling a camera-person to select the most desirable filter for his or her application

Also ranking high on a professional's list are the Tiffen center spot and the star effect.

The center spot, clear in the center and diffused in its outer perimeters, is ideal for focusing attention on a subject that is surrounded by a busy or distracting background.

Tiffen star effect filters, supplied in four types (4pt, 6pt, 8pt, 12pt) are used in all phases of image-making including televised sports, major motion pictures and commercial still photography.

In addition, the Tiffen special-effect line provides a host of filters that improve, add or correct color.

The Tiffen polarizer, for example, one of the most practical filters in any cameraman's collection, is noted for imbueing a blue sky with deeper, more dramatic color.

A unique color-improving filter is the Tiffen Enhancing filter, which creates brighter, more saturated reds, oranges, and rust-type colors. It is especially useful during the fall season to bring out the colors of the autumn foliage.

Another popular color filter is the Tiffen Sepia, a golden brown filter that is used to give a contemporary scene the look of yesteryear.

But perhaps the one filter that has gained unparalleled notoriety among cameramen is the Tiffen Color-Grad®, a filter that is half clear and half color. Custom made to meet the demands of the cinematographer, it is used to add or change color to half a scene, particularly the sky. For example, a color-grad red is ideal for dressing-up a sunset. A color-grad blue or green is used to enhance the colour of water. And color-grad neutral is used to achieve an even exposure in a scene that contains an uneven lighting situation.

Tiffen filters come in a variety of sizes and shapes, many of which are designed to fit into filter holders or professional motion-picture matte boxes.

The Tiffen Difference

There are several key aspects that set Tiffen apart from other filter manufacturers:

☐ The Tiffen Laminate Process
☐ The Kodak Wratten System
☐ Custom filters and adapter rings
☐ A 10-year limited warranty
☐ Metal rings
☐ Dynamic advertising

The *Tiffen Lamination Process* is the method that Tiffen uses to make their filters. It was developed and patented by Nat Tiffen, President, who later received an Academy Award for Technical Achievement from the Academy of Motion Picture Arts and Sciences in recognition of this process.

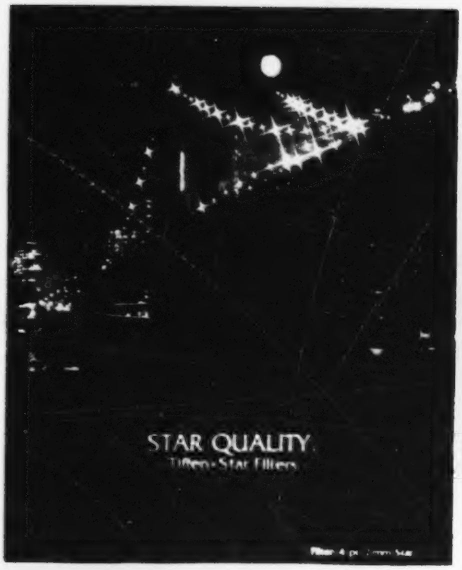
Tiffen filters exceed US military standards and are used by NASA for space photography. Many filter colors conform closely to the *Kodak Wratten System* for ease of use.

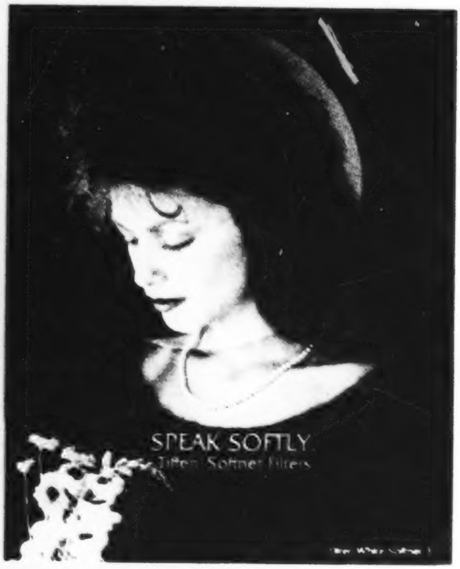
Tiffen understands the needs of the professional. For decades, Tiffen has been making *custom adapter rings and custom filters* for all types of unique applications. A classic example is the set-screw adapter ring, which has made it considerably easier for camera people to use filters on a lens that has no threads.

Because of Tiffen's commitment to quality, they are the world's only filter manufacturer to offer a *10-year limited warranty*. In addition, all Tiffen round filters are supplied with *metal rings*.

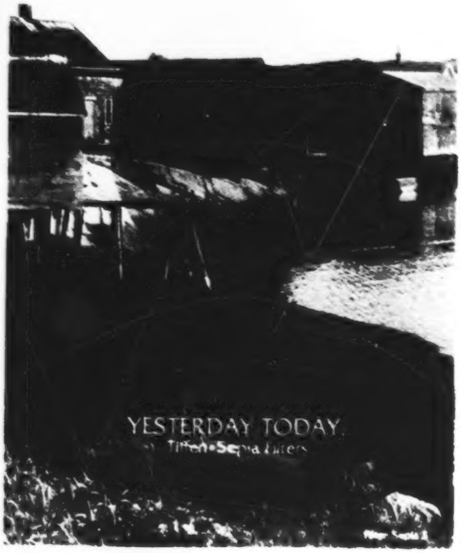
Tiffen gets its message out through its *dynamic advertising*. Their ads run periodically in major magazines, trade newspapers, and international directories. Its theme is simple. For better image making, use a quality filter . . . Use a Tiffen Filter. ☐

TiFFEN Filters - Create a world of your own!


STAR QUALITY.
Tiffen•Star Filters


SPEAK SOFTLY.
Tiffen•Softner Filters

RMING TREN
Tiffen•812 Filter


YESTERDAY TODAY.
Tiffen•Sepia Filters

Discover the world of Tiffen. The widest range of filters, special effect filters and lens accessories. Precision made with the finest optical glass. Consistant colors. Accurate. Dependable. Made to perform. Backed by a 10-year limited warranty.

TiFFEN / MANUFACTURING CORPORATION

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MORGAN'S
FOR THE BEST IN
BROADCAST

VIDEO PROJECTION, CAMERAS, AUDIO & LIGHTING

MORGAN LABORATORIES has rapidly established itself as the first choice for the real professional.

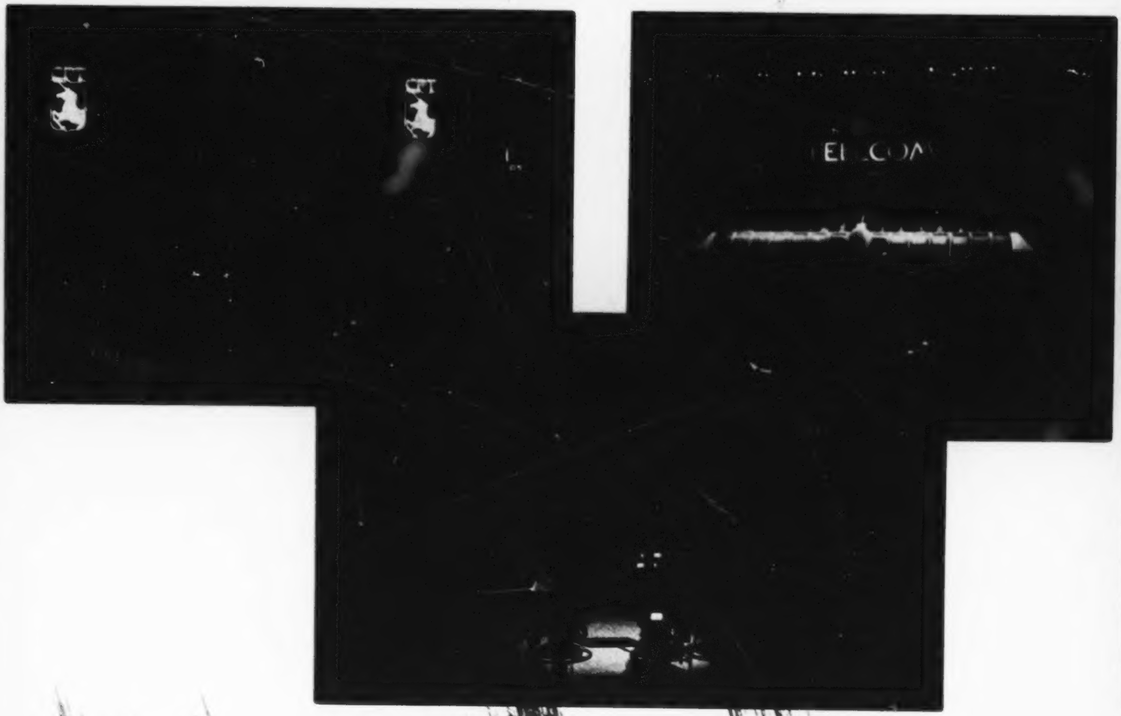
We have grown in little more than 5 years to offer a full range of services — no matter what field of video you work in.

Our large stock of monitors and video projectors are capable of producing video or computer generated pictures from 6″ to 25′ wide with exceptional brightness and clarity. These are complemented by a wide range of video cameras and recorders all of which are available for hire at extremely competitive prices.

Should you require technical backup our fully trained technicians will assist at any level in your presentation to ensure its smooth operation.

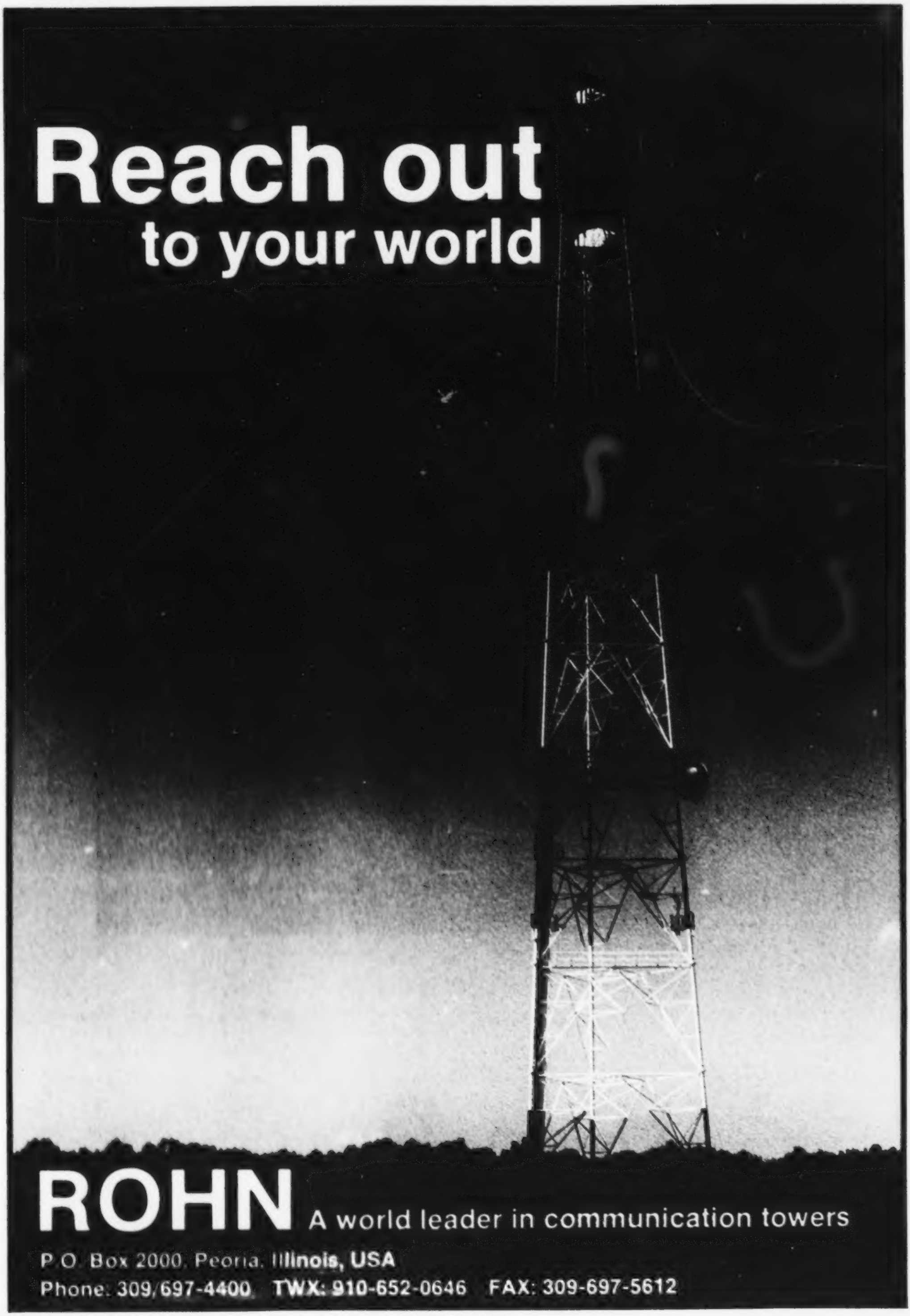
Morgan
Laboratories

MORGAN'S
FOR THE BEST IN
BROADCAST



Morgan
Laboratories

VIDEO PROJECTION, CAMERAS, AUDIO & LIGHTING
Unit 4 · 16 Wembley Commercial Centre,
East Lane, Wembley, Middlesex Great Britain HA9 7XD.
Telephone 01-908 3856/01-907 7602/01-908 6377
Telex 935921 MORGAN G


Reach out
to your world

ROHN A world leader in communication towers

P.O. Box 2000, Peoria, Illinois, USA
Phone: 309/697-4400 TWX: 910-652-0646 FAX: 309-697-5612

TO EXTEND OUR REACH

Since the very beginning of civilization man has searched for better and more efficient methods of extending his world through communications systems.

Communication is nothing more than reaching out to receive or send information of any kind. The earliest systems used simple amplification, the most modern use microwaves and satellites.

Towers are the backbone of extended communications. They lift antennas over the terrain to listen and broadcast. Towers extend our reach by extending our communications beyond the limits of ground based antennas.

Designed for strength and built to last, Rohn towers have been chosen worldwide since 1948 to extend communications capabilities in more than 60 nations.

DESIGN AND STRENGTH

A tower has to be more than just a collection of steel and bolts. It must be the final product of superior engineering, materials and construction - a product built to do a job and do it well.

The design of a communications tower is dependent upon the location of the tower and type of service expected of it. Rohn is versatile and manufactures towers of solid rod or pipe construction in guyed or self supporting configurations.

Sizes range from 10 meters to 450 meters with design wind velocities of up to 250 KM/HR, or more special applications.

For uneven terrain, special antenna loading or other unusual situations such as the need for a large platform, Rohn's custom engineering and fabrication can produce a tower to do the job.

Rohn towers are available with a wide range of accessories including:
Anchor bolts
Climbing ladders, cages and safety cables
Platforms or landings
Lightning protection and grounding
Antenna mounts and frames
Feeder support ladders
Factory painting after galvanizing
Obstruction lights
Base Insulators or guy line insulators

PROTECTION

All of the steel used in a Rohn tower is Hot Dip Galvanized in Rohn's own galvanizing facility after fabrication to provide the metal with a quality bonded zinc coating of protection against corrosion. With Rohn's special Hot Dip Galvanizing the zinc actually becomes a part of the steel, not just a painted on layer which can chip or scratch.

Galvanizing insures a longer tower life and reduces the need for maintenance of the surface metal - important considerations for any tower and vital when the tower is to be in a remote area or subjected to severe weathering conditions.

WHEN EQUIPMENT BUILDINGS ARE NEEDED

Rohn equipment shelters are built to match Rohn towers in strength, durability and ease of maintenance.

From two meters by two meters up to 4 meters by twelve meters in size Rohn equipment shelters are engineered to provide a safe, protected and long lasting environment for the expensive and complex equipment needed at some tower sites.

Rohn equipment shelters feature a fiberglass outside surface for low maintenance and long life. When specified Rohn also can provide the best in concrete shelters.

Each shelter is custom built and equipped to meet the special needs of the system it will become a part of. Optional bulletproofing is available on Rohn shelters.

CONSTRUCTION

Expert on-site construction of a tower or shelter installation is vital to maximum performance. The Rohn Construction Group of trained specialists can complete installations worldwide.

To find out more about how Rohn can help extend your reach contact:

ROHN

P.O. Box 2000
Peoria, Illinois 61656
USA
Phone: 309/697-4400
TWX: 910-652-0646
FAX: 309-697-5612

Thomas

JAMES THOMAS ENGINEERING LTD

Station Approach, Pershore Trading Estate,
Pinvin, Nr. Pershore, Worcestershire.
Telephone (0386) 553002 (2 lines)
Telex 336808 PARCAN G

Engineering Services and Specialists to the Entertainment Industry
Fabrications Presswork Metal Spinning Steel & Aluminium Welding

The Company was started in 1977 by James Thomas and John Walters in a small workshop in the Heart of Rural England when a need was identified in the Concert Lighting Industry for a lightweight PAR fixture. A prototype was fabricated from sheet aluminium and after discussion with several major Lighting Hire Companies the first spun lightweight aluminium PAR 64 Lantern evolved.

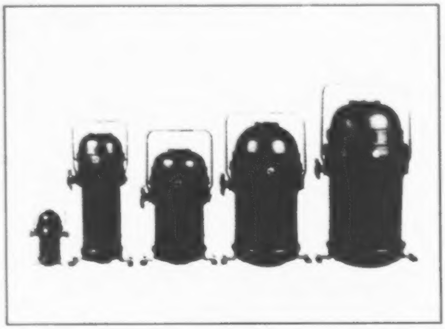
The Company now consists of three Directors: James Thomas (Managing), John Walters and John Hickinbotham and approx 35 employees, and manufactures a complete range of equipment for the Entertainment Industry.

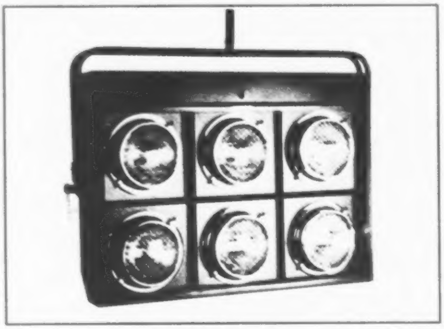
We supply most of the major countries in the world through universally appointed agents. Amongst our customers we are pleased to name:
The Royal Shakespeare Co., Royal Opera House, most major Theatres and shows like 'Cats', 'Starlight Express', 'Evita', 'Chess' etc.

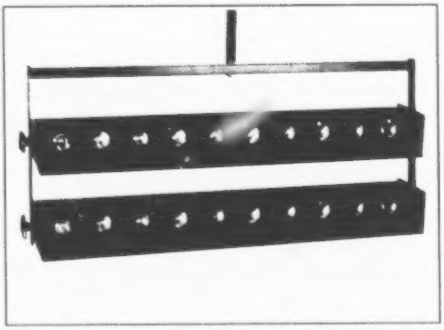
Our equipment is used for many touring bands and groups, ie Queen, Elton John, AC/DC, Iron Maiden and many others.

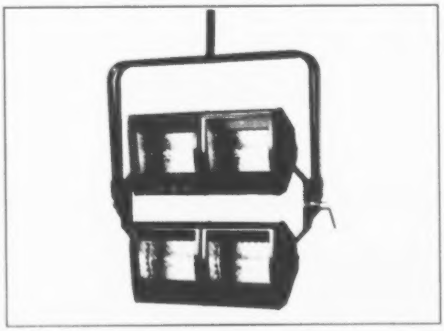
Our products were also used recently on the Live Aid concerts in England and the US.

A full range of light fixtures from PAR 16 to 64 also 500W and 1000W Cycs and are all aluminium construction.





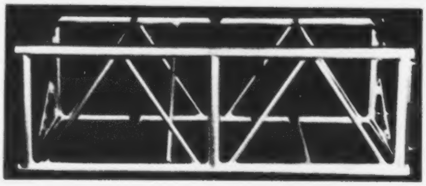


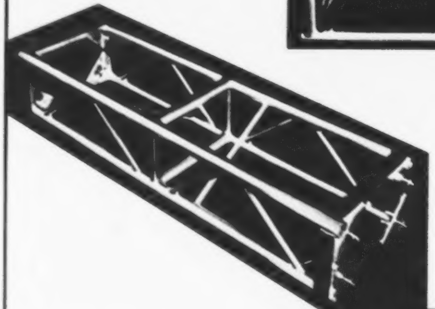


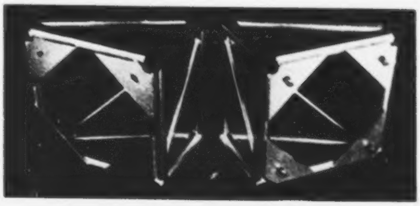
Thomas

JAMES THOMAS ENGINEERING LTD

A selection of Thomas trussing. All aluminium construction. Technical information available on request. All items shown are manufactured in England by James Thomas Engineering Ltd.







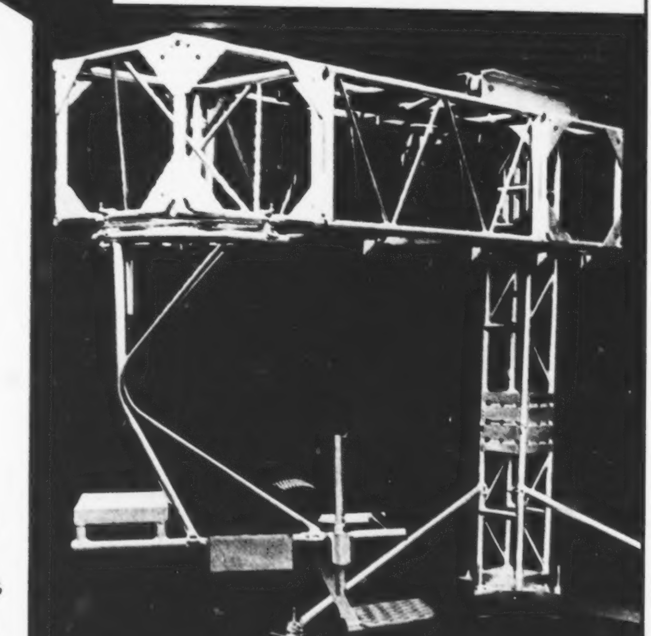
ITEMS SHOWN

TOP:-
5′ SECTION OF GENERAL PURPOSE TRUSS

LEFT:-
5′ SECTION OF 18″ × 12″ LIGHT DUTY TRUSS

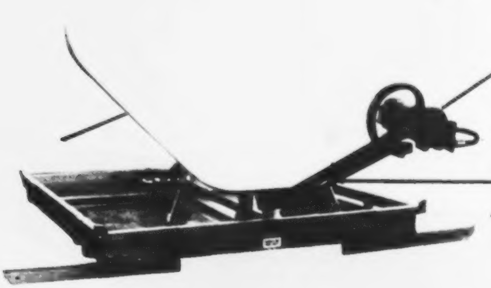
RIGHT:-
GENERAL PURPOSE 270″ HINGE UNIT

BOTTOM:-
PRE RIGGED CORNER BLOCK. 5′ PRE RIGGED TRUSS WITH LANTERNS. UNDERHANGING FOLLOW SPOT CHAIR AND SHORT SECTION OF FREESTANDING GROUND SUPPORT SYSTEM



Multipoint Communications Ltd

SATELLITE HOUSE, EASTWAYS INDUSTRIAL PARK, WITHAM, ESSEX CM8 3YQ ENGLAND
Tel: (0376) 510881 Telex: 987313 MPOINT Fax: 0245 287221



RANGER

NEWS GATHERING AND VSAT

VIDEO DEMODULATOR
FOR T.V. RECEPTION
5dB

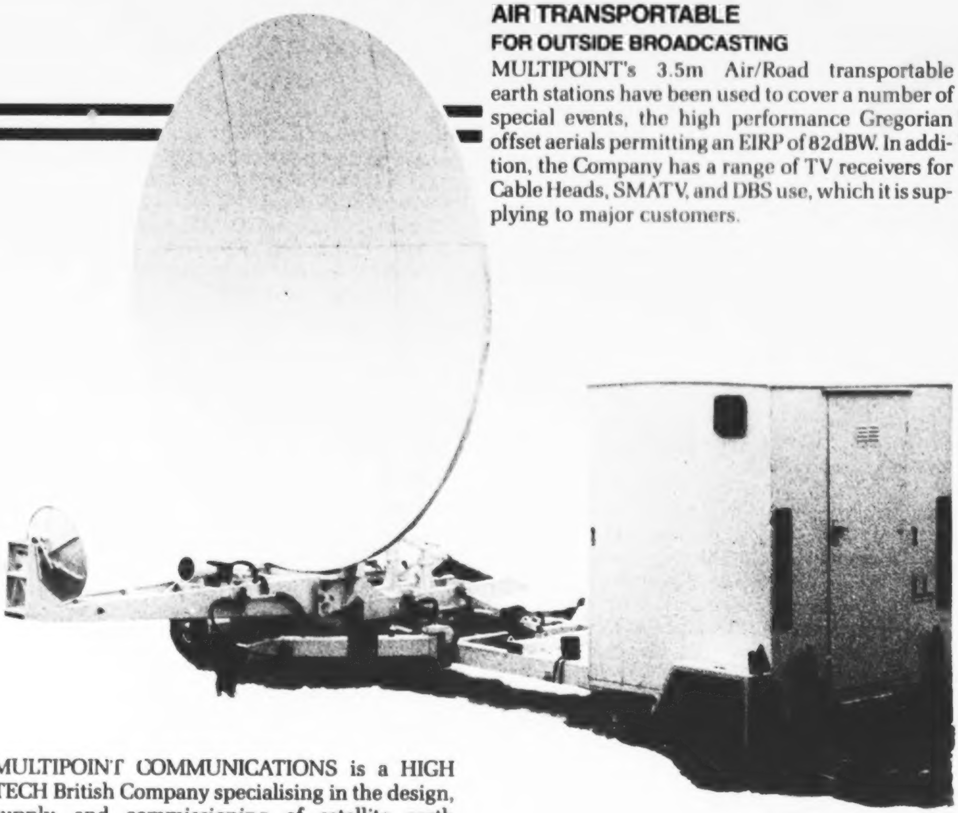
Multipoint

SATELLITE RECEIVER
FOR DOMESTIC USE

AIR TRANSPORTABLE

FOR OUTSIDE BROADCASTING

MULTIPOINT's 3.5m Air/Road transportable earth stations have been used to cover a number of special events, the high performance Gregorian offset aerials permitting an EIRP of 82dBW. In addition, the Company has a range of TV receivers for Cable Heads, SMATV, and DBS use, which it is supplying to major customers.



MULTIPOINT COMMUNICATIONS is a HIGH TECH British Company specialising in the design, supply, and commissioning of satellite earth stations for transmitting and receiving video, voice and business data over the Intelsat, Eutelsat and other national satellite networks. The Company was formed in 1981 and is supported by a highly professional team with a long pedigree in the field of satellite communications. The Company operates from a modern factory, fully equipped with a comprehensive range of test equipment, operational aerials, software and services necessary to support complicated projects.

COMPANY STRUCTURE

To ensure proper PROJECT MANAGEMENT and CUSTOMER SUPPORT the Company is divided into four product areas each with its own Product Manager, production team and marketing support. The product teams can be quickly enlarged for major contracts.

Central services include Drawing Office, Documentation, Purchasing, Financial Control and Administration.

The Company's quality control is to BS5750 and this has been vetted by several major customers.

ACHIEVEMENTS

MULTIPOINT COMMUNICATIONS has successfully completed a number of new initiatives in Europe. The Company was first to supply and commission a 12GHz satellite business network to Europe and has terminals operating in many European Cities. The Company was the first to install an INTELSAT IBS 'OPEN NETWORK' business link between Europe and the USA.

For outside broadcast events and television reception MULTIPOINT have set new standards in transmission and reception from small dishes. The 1.4m RANGER transmit/receive earth station has sidelobes of only 21-25 log Theta permitting a high radiated power. World coverage is further enhanced by the company's low threshold TV receivers exhibiting a threshold of 5dB C/N.

MTC's DIVERSIFIED PRODUCT LINE PROVIDES SOLUTIONS TO ANY VIDEO DUPLICATOR'S DISTRIBUTION, QUALITY AND MACHINE CONTROL PROBLEMS

Mycomp Technologies Corporation (MTC), a young and dynamic company dedicated to design and manufacturing excellence, responds quickly to the technological needs of the burgeoning video duplication industry by providing precision-crafted, easy-to-operate equipment to fulfill those varying requirements ... and MTC takes pride in its availability and willingness to assist customers after delivery. Leading video duplicators worldwide rely on MTC quality to increase their own efficiency and productivity.

Whether your facility houses 8 or 8000 recording VCRs, MTC has the product to help you complete your job more efficiently.

Audio-Video Distribution Amplifier

MTC's DA-108 establishes a new industry standard in low-noise, wide bandwidth and long-term reliability. This product features floating isolated video and audio grounds, balanced inputs, very high output to output isolation, audio outputs of -10dBv, front panel adjustments for level, common mode rejection and system equality. The single rack unit high DA-108 provides extremely low distortion signal paths for use with high fidelity recorders and digitally mastered audio sources.

Duplicon 8 Controller

MTC's Duplicon 8 offers the industrial duplicator or training professional the high quality convenience and efficiency features of machine control previously cost effective only for the largest duplication facilities. The back panel of the Duplicon 8 features eight isolated serial outputs for command and control communication to the recording VCRs and a single status feedback interconnection to the initial VCR in the system. Eight pushbuttons on the Duplicon 8 front panel allow selection of the operating modes for the VCRs. The Duplicon 8 sets all recording machines to identical functions simultaneously. The illuminated buttons keep the operator aware of the machines' status at all times during the recording process. MTC's Duplicon 8, which is powered by the initial VCR, draws .28 amps at maximum load and is NTSC and PAL compatible.

Automatic Cassette Changer

MTC's Automatic Cassette Changer mounts on the face of the VCR and allows automatic loading and unloading of up to four video cassettes. Duration of an individual operating cycle is 15 seconds. A single motor drives the changer assembly which electronically monitors the applied torque to prevent damage to the machines or cassettes during operation. The 12 volt power requirement for the changer emanates from the VCR to which it is attached. MTC's Cassette Changer employs no rubber friction devices to move tapes. The drive mechanism senses an incorrectly oriented tape in the hopper and prevents its insertion into the machine. A front panel illuminated FAULT/RESET button alerts the operator to any malfunction, while an EJECT button allows a technician to locally eject a tape for maintenance purposes. Monitoring of the VCR's recording status is done via a front panel indicator lamp.

UNICON Package

MTC designed and built UNICON to provide maximum control in minimum space. The compact two rack unit high device offers universal control with integrated signal distribution, remote machine control and automated quality control and switching built in. Each package interfaces to eight Bidrex™ modified VCRs via separately addressable and controllable output connectors which permit individual machine control, analog signal monitoring and status feedback. Quality checking is done automatically at the end of the recording pass, precluding the need to relocate the completed tapes to a separate QC area. An outboard, custom configured 20-button control panel supplies the command input vehicle for the UNICON system. Within the UNICON package the distribution amplifier circuitry provides each VCR with 75 ohm video and 33 ohm audio outputs. Front panel test points and trims allow adjustment of audio output signal levels, video quality and high frequency signals.

Systems

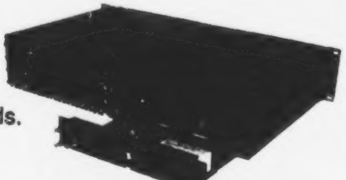
MTC designs, manufactures and supports complete turnkey Video Duplication Systems including Parallel and Serial Machine Control systems, applications software packages, and automated Quality Control Systems for varying sized video duplication facilities.

MYCOMP TECHNOLOGIES CORPORATION
200 McCormick Avenue
Costa Mesa CA 92626 USA
Phone (714) 545-5111
Telex 855065 MYCOMP TECH

ANTICIPATING A PROBLEM DOWN THE LINE?

AN MTC PRODUCT OFFERS THE SOLUTION TODAY!

Growth seems to be the general watchword in the video cassette duplication industry...and growth often creates new problems. MTC maintains a strong communications link with its customer base and keeps current on surfacing concerns within the industry. An equally strong commitment to thorough, on-going R & D generates quick responses from MTC to these customer needs. Let us share our expertise with you.

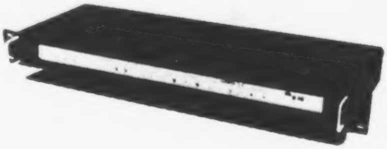


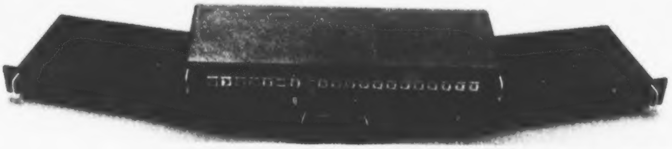
Besides offering a diversified product line for varied sized duplication facilities, MTC backs all of its products with an unprecedented five-year warranty on all parts and labor.

MTC Manufactures.........

- DA-108 Audio-Video Distribution Amplifier
- SVC-408 Duplicon 8 Controller
- MCDS-833 Unicon System
- ACC-01 Automatic Cassette Changer
- DRC-001A Bus Controller
- DRC-120 20-Button Transmitter
- DRC-202 Two-Channel Receiver
- DRC-208 Modular Receiver
- EB-308 Expansion Box

and more....

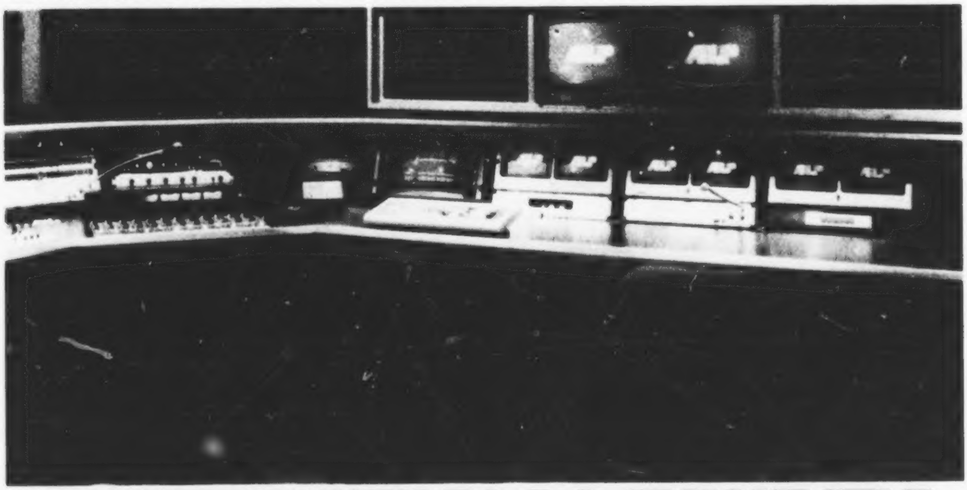




This is only part of MTC's story. We welcome your inquiry.

MYCOMP TECHNOLOGIES CORPORATION
200 McCormick Avenue
Costa Mesa CA 92626 USA
Phone (714) 545-5111
Telex 855065 MYCOMP TECH

BROADCAST/PRODUCTION FACILITIES:



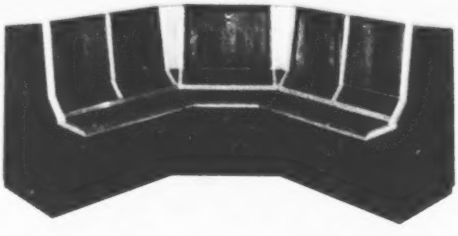
FROM TURNKEY TO DO-IT-YOURSELF.

Public demand for greater production values in entertainment, educational and news programming is increasing. Private enterprise now embraces video for sales and training materials. The net result: broadcasting and teleproduction facilities are expanding their capabilities, and new facilities are being built at an alarming rate.

Each facility will undoubtedly have its own special needs. Certain functional requirements will be common to them all, however, there will also be certain aspects of each facility that are truly unique. Analyzing the requirements of any production or post-production installation is best done by an experienced systems integration company capable of addressing a wide variety of needs.

Centro Corporation of Salt Lake City, Utah is emerging as the leading choice of broadcasters, independent production and post-production houses as well as corporate video operations. As a leading facilities manufacturer, Centro uses a highly organized approach to project management. Each task, from initial design considerations to final installation, is carefully monitored to insure that every facility will meet performance, budget and deadline targets.

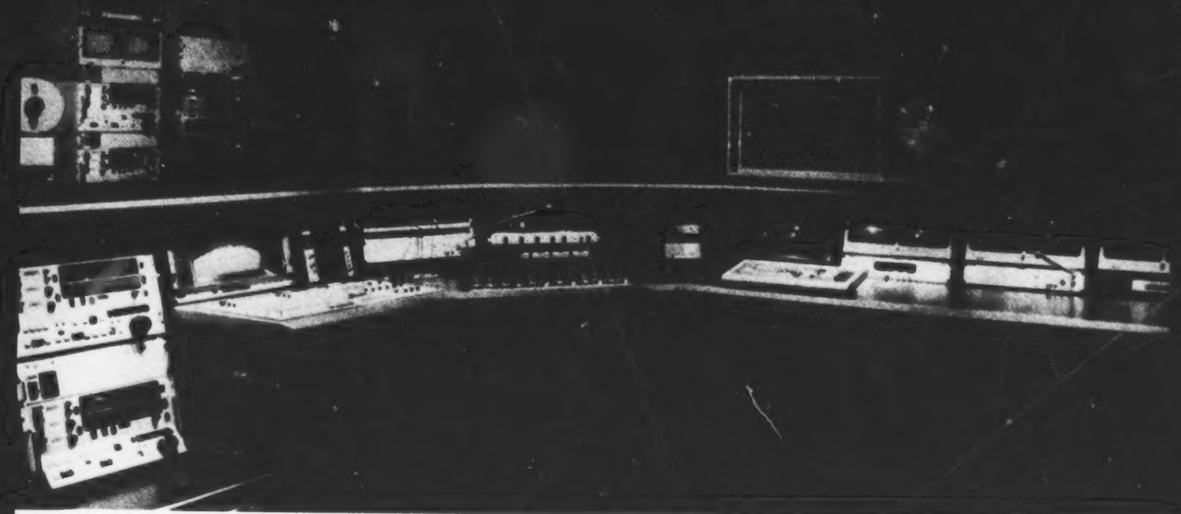
Recognizing that many smaller video operations were being developed with cost constraints prohibiting the turnkey approach, Centro has capitalized on their many years of experience, designing modular consoles and racks. Built to the same strict specifictions as their custom systems, these components are quite economical, very versatile and aesthetically unsurpassed. Centro can provide consultation to help you configure these "building blocks" to your specifications.



After expert fabrication, your systems furniture will arrive on site ready for equipment installation and hook-up.

Whether your needs are for a total turnkey facility or limited systems assistance, Centro is able to tailor their services to meet your special needs.

Centro Corporation, 369 Billy Mitchell Road, Salt Lake City, Utah 84116 1-800-654-4870



No one has the facility to meet your needs quite like Centro.

The demand for greater production values has existing broadcast and teleproduction facilities expanding and new facilities opening at an amazing rate. The need for professional systems integration has never been greater.

At Centro, we know from experience that there are common facility requirements. We are also savvy enough to realize there are very special aspects of each facility which are totally unique.

We know, too, that a highly organized approach to project management is the key to the successful completion of facilities large and small. From the initial concept meeting to handing over the keys, we carefully monitor each step of every project to insure we will meet all performance budget and deadline targets.

We also recognize that many smaller facilities are being developed subject to modest budgets. In response, we have developed a unique approach to systems furniture: modular consoles and racks. Built to the same strict specifications as our custom turnkey systems, these components are surprisingly economical, very versatile and aesthetically unsurpassed.

A unique approach to systems furniture.

So, whether you need a total turnkey installation or custom consoles and racks, we have the facility to meet your needs, just give us a call.

Centro is a subsidiary of Skaggs Telecommunications Service, an American Stores Company

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Centro

Centro Corporation
369 Billy Mitchell Road
Salt Lake City, Utah 84116
1-800-654-4870

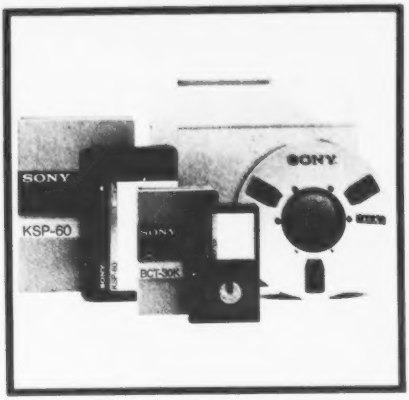
SONY®

The name for all reasons

Professional Video

Professional Audio

Professional Systems



Professional Tape

A total Broadcast capability.

SONY®
Broadcast

Sony Broadcast Ltd.
Belgrave House
Basing View, Basingstoke
Hampshire RG21 2LA
United Kingdom
Telephone (0256) 55 0 11
International +44 256 55 0 11
Telex 85 84 24
Fax G2/G3 (0256) 474585

PROGRAMMABLE MULTI-SITE TRANSMITTER CONTROL

National and regional broadcasting systems cover the required area and number of simultaneous program channels by utilizing many transmitter sites. It is desirable (and often legally required) to control and monitor broadcast transmitter sites from a central location. The DRC190 by Hallikainen And Friends is a programmable Multi-Site telemetry and control system that operates over a variety of voice-grade communication circuits.

PROGRAMMABLE - Applications programs are written in Basic specifically for the system to be monitored. This program may run in any of the DRC190 units, or may run in an external computer. Programmed operation in the control point DRC190 allows the use of display terminals for operator interaction. Operator interaction is through the terminal keyboard, or optional "Touch Screen". The program also makes adjustments or brings up alternate equipment based on measured or calculated parameters. Programs can also generate a station log and a "daily report," showing the minimum, maximum and average for each parameter.

The use of a standard high level language (BASIC) to configure the system to meet the exact requirements of the specific broadcasting system is unique to the DRC190 by Hallikainen And Friends.

MULTI-SITE OPERATION - The DRC190 allows the monitoring and control of up to 100 sites over a single two-way voice grade circuit. The system mixes "token passing" and "carrier sense multiple access with collision detection" protocols to allow site-to-site communication. Status, metering and control of any site is available at any other site through the front panel or through a BASIC program running at that site.

Communications occurs through a variety of voice-grade circuits at 1200 BAUD using half-duplex Frequency Shift Keyed audio. The units communicate in a "bus" or "star" network link of dedicated wire circuit, broadcast or microwave sub-carrier, or dedicated radio link.

The DRC190 includes a direct connect modem option controlled by a BASIC program at the modem site to dial out, send and receive data over public telephone networks.

OTHER FEATURES - The DRC190 includes an intercom circuit that allows voice communications between all the sites in the system. All data calibration is in a protected EEPROM, which is user-modified from the front panel. Each site may have up to 100 metering samples, 96 status samples, and 100 raise/lower control pairs. Each site may have battery back-up, or be powered by a variety of DC voltages.

Hallikainen And Friends has been providing innovative approaches to transmitter control since 1974.

HALLIKAINEN & FRIENDS Telephone (805) 541-0200
Telex 4932775 HFI UI
141 Suburban Road, Building E4 • San Luis Obispo, CA 93401-7590 • USA

Auditronics Consoles Perform Better And Last Longer

Our audio consoles are superior to most broadcast products in two respects. First, they are designed to deliver the highest signal purity attainable. Circuit path length is minimized and all in-line components are chosen to be noise and distortion-free.

Second, our consoles are designed to provide a trouble-free operative life in excess of ten years even in hostile environments. Our decades-old reputation for on-line reliability is legendary among broadcasters throughout the world.

200 Series For The Small To Large Radio Broadcaster

For radio on-air and production, Auditronics 200 series consoles are supplied with six, twelve, eighteen, or twenty-four input positions. This allows the 200 to fulfill all requirements from a single newsroom operation to a multi-studio facility.

Modular construction allows a wide variety of functions to be performed by standard plug-in units that include: three band sweep equalizer, voice equalizer, compressor/limiter/noise gate, telephone interface, digital clock, event timer, remote controls for tape recorders and numerous others.

310 Series For Television Broadcast Production/On-Air

Auditronics 310 console is an entirely new concept in console layout and construction developed specifically to meet the needs of program producers. Controls are arranged and marked for ease of use and require minimum learning time. Every needed control and function is available in a user-programmable system that interfaces live mike feeds, sound effects, VTR's, switchers, editors and other functional blocks. The 310 is an expandable system with many types of standard modules that allow you to select the exact system you need now and modify it later when desired.

400 Series For The Major Radio Broadcaster

The 400 series is a high-performance console designed for multi-track tape production. Additionally, it may be configured as a very flexible on-air console by selecting the appropriate group of plug-in modules.

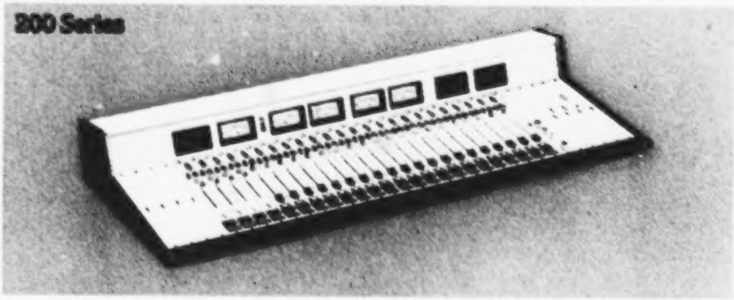
Standard mainframes are available for 12, 18 or 24 input positions, and are designed to fit into a desk-top cut-out. All the accessory functions of the 200 series are available, in addition to LED light bar metering with choice of conventional VU or peak ballistics. Complete machine control logic is standard.

1000 Series For The Small Radio Broadcaster

Auditronics 1000 Stationmaster consoles offer all the signal quality of our larger units, but in a small package with conventional rotary knob controls and a minimum price.

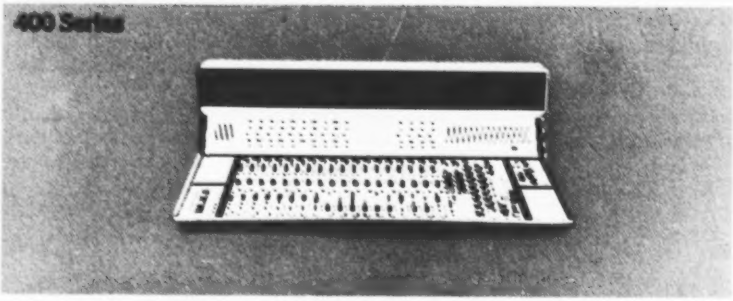
Models are available from 6 to 12 mixing positions. All include illuminated push-button switching, quick-change, plug-in circuit boards and many other features usually offered only in much more expensive consoles, such as machine control logic.

For complete information about the broadcast consoles that perform better and last longer, contact:

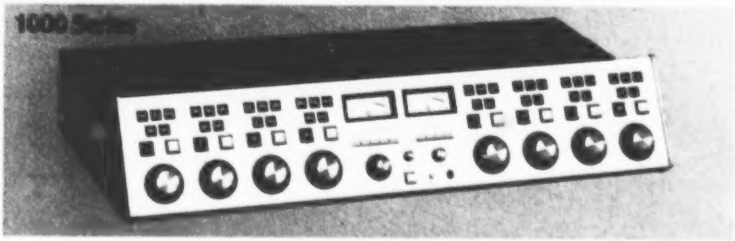


200 Series

310 Series



400 Series



1000 Series

3750 Old Getwell Road, Memphis, TN 38118 U.S.A.
Telephone: 901-362-1350   Telex: 533-356

auditronics, inc.

BROWNING LABS INC.

BROWNING LABS, INC. of Miami, Florida, USA was formed in 1984 to provide the broadcast industry with a reasonably priced line of Television and FM broadcast transmitters. With the recent announcement of the new 25 kilowatt, model TVT-25000V, VHF television transmitter, the product line has grown considerably. The 25 kilowatt transmitter is all solid-state except for the final tube. The tube used in the output stage is a high efficiency RCA tetrode. This transmitter rounds out the complete line of VHF and UHF television transmitters, translators, and microwave links. From a 100 watt solid-state VHF transmitter, introduced in 1984, to various transmitters ranging from a 10 watt driver to 25,000 watts VHF (5,000 watts UHF).

BROWNING LABS, INC. has the capabilities of custom building transmitters for special frequencies and applications. The company can provide PAL, SECAM, as well as NTSC modes of operation. Special options such as over the air scrambling and switching from one standard to another standard are easily accommodated.

The company's emphasis on solid-state transmitters has proven to be successful in the field. The solid state transmitters are constructed by paralleling ultra-linear amplifier modules to obtain the power level required. This parallel operation provides redundancy and eliminates lost air time from a single point failure in the amplifier section. However, due to the number of amplifier modules required, this becomes impractical at power levels above 1000 watts. With several hundred transmitters operating around the world, this design has proven excellence in regard to performance with minimal down time.

BROWNING LABS, INC. policy on service after the sale includes technical assistance via telephone, or telefax, 24 hour turn around on replacement parts, and providing field service engineers at a reasonable fee upon request for most areas of the world. The factory can also provide in-house training of the customer's service personnel.

Other services provided by BROWNING LABS, INC. range from system planning to field installation in most parts of the world. Antenna systems, towers, and feed lines can be specified or provided as required. Other accessories such as STL links, video support equipment, and test equipment can also be specified or provided.

For additional information contact one of our sales representatives below, or contact our sales manager Russell Thom (305) 885-3356, FAX: (305) 885-0426, TELEX: 529750.

ARGENTINA
M. Huller S.R.L.
Virrey Linieres 454
Buenos Aires, Argentina, S.A.
541 88 2547, 88 2314, 887065

EL SALVADOR
Carlos Estrada S.
CEQ El Salvador S.A. de C.V.
79 Avenida Norte, 5ta. Calle Poniente No. 403
Colonia Escalon, San Salvador, El Salvador
23 0858

VENEZUELA
Efrain R. Sauri
Apartado 70188
Los Ruices, Caracas 1071A
Venezuela, S.A.
58 22 84 1242

BOLIVIA
Impresa Alba
Juan Arteaga
Avenida Sanches Bustomante, #451
Calacoto, La Paz, Bolivia, S.A.
32 1518, 79 0028

PERU
Alfredo Suarez
TV-Sat
Avenida Mejico 1123
La Victoria, Lima, Peru
51 14 72 8358

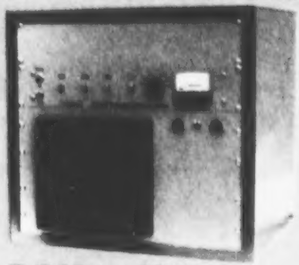
BROWNING LABS INCORPORATED
PRESIDENT: ROBERT B. BROWN
TREASURER: CARLOS DE ZAYAS
Sales Manager: Russell Thom
Production Manager: Gary G. Willhoite
Customer Service: Angelo Enriquez

BROWNING LABS, Inc.

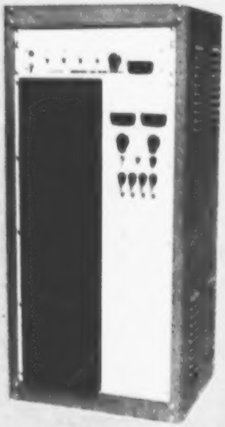
Television Transmitters

☗

EX-15V — 15 Watt Exciter VHF
EX-10U — 10 Watt Exciter UHF
DR-15V — 15 Watt Driver VHF



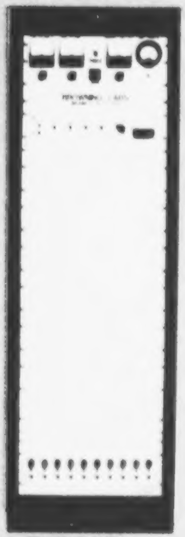
TVT-25V 25 Watt



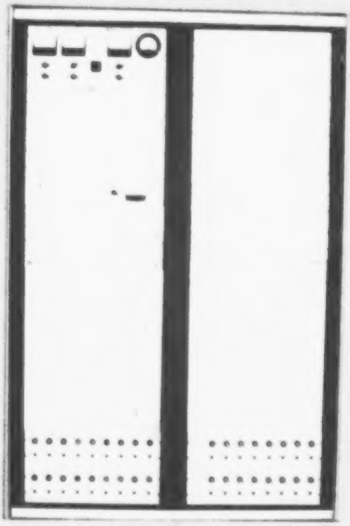
TVT-100V — 100 Watt VHF
TVT-100U — 100 Watt UHF

☗

May be packed
for Airline
Express Baggage



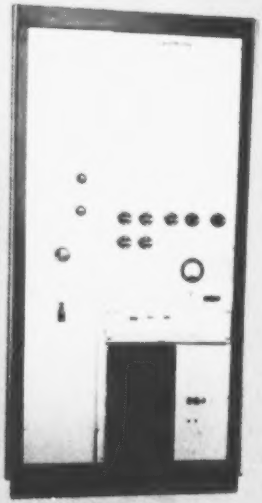
☗ TVT-250V
250 Watt
Solid State



☗ TVT-1000V
1000 Watt
Solid State

☗ Field Installation
Available

48 Hr. Burn In
Factory Test



TVT-2500V
2500 Watt, one tube

Ph.: (305) 885-3356

FAX (305) 885-0426

INDEPENDENT EXCELLENCE IN AUDIO POST-PRODUCTION

Probably the largest audio post production centre outside of London, and certainly the most competitive and comprehensive in terms of cost and facilities in the U.K. today is located in Cardiff, capital city of Wales and home of the **Eco** complex.

Eco – the complete audio post production facility where every demand – from revoicing and dubbing to editing, captioning, equipment hire and more – can be met in house. Our 20,000 square feet of working room provides 5 I.B.A. standard studios, all equipped with the best that modern technology has to offer.

Studios 1 and 2 are custom-built fully air conditioned studios with comfortable, spacious working areas in both viewing and commentary rooms.

Picture presentation for dubbing is effected by use of 2540mm (Studio 1) and 2030mm (Studio 2) diagonal projection televisions with electronically injected footage count. Standard monitors are provided for the producers position at the end of the mixer.

Eco is a specialist in audio post production, both in quality and technique and, in Studio 1, you will find video dubbing at its best.

Equipment in use includes 16 Track A80 Studer with Dolby, locked via Q-Lock to JVC 6600 Lo-Band Umatic, Soundcraft 2400 series mixing desk, Studer B67 ¼" tape machine, B + E CART machines.

Our facility in Studio 2 can be used for dubbing 16mm film or Video tape using film sepmag tracks; mixing onto 16mm EBU 2 track, stereo or 35mm triple track.

Equipment includes high speed rock 'n' roll x 30 speed, Perfectone 16mm sepmag, Magnatec 16/35mm sepmag machines, Soundcraft 2400 series mixing desk, AMS Digital Delay Unit, 8 track audio machine capable of locking with film equipment and a range of varied footstep surfaces.

The Transfer suite includes 16mm sepmag, 16/35mm sepmag, Studer B67 and A810 ¼" tape machines and an extensive sound effects and music library. Stereo, Mono, Nagra, Compact Disc, PCM. Umatic to VHS transfers.

Productions associated with Studio 2 include HTV co-productions – **Treasure Island, Arch of Triumph, Canterville Ghost, Police Precinct** (from French) for Yorkshire T.V. and **Goya** (from Spanish) for UK Channel 4. Also a number of productions for S4C.

Studios 3 and 5 are both IAC built, are extremely competitive, very well equipped and ideal for revoicing productions (with final mix if required in Studio 1), smaller video productions and corporate videos.

At **Eco**, we specialise in revoicing work. No compromise is made in terms of equipment or production quality. Our lower costs are achieved purely due to our lower overheads. The result is a very special revoicing package. A package that can include everything from the provision of directors, actors, voice-over narrators, IAC studios, dubbing, transfer facilities, video titling, captioning, editing, and computer generated graphics. All from one source, all under one roof.

You will find that our range of equipment will include the best of advanced technology to ensure the highest possible production standards. Equipment such as our AMS Audiofile digital recording and Branch & Appleby ADR units for maximum levels of sound purity and efficiency at work.

Recent revoiced programmes include **Goya**, **Pepe Carvalho** for RTVE, **Telecat**, for the Children's Channel, and **Peppino** for Telepool Zurich.

Come to **Eco** with your revoicing and we will be pleased to discuss your requirements and provide a fixed price quotation.

Today, effective communication demands more effective use of audio visual methods and **Eco** provides a range of services designed to assist and improve corporate communication and training through use of audio visual presentation. These can include corporate video production with provision of voice over narration, dubbing, sound effects, and music. Similarly, visual presentations can be enhanced with the addition of computer generated graphics, editing and captioning, all of which are available within the **Eco** building.

Come to Eco for your audio post production requirements and you will find professional dedication to the highest standards of sound excellence – both in equipment and expertise.

A standard that can be measured by an impressive list of U.K. and European clients with successful, often award winning, productions for national and international distribution. At Eco, we can put todays technology to work on your behalf.

independent post production facilities for film and video

ECO

Whether for film or video, every demand – from dubbing, revoicing, transfer, effects, captioning and more – can be met within the most competitive and comprehensive facility in the UK today.

Enlist our professional dedication for your next production. To find out more, please request our information pack today.

ECO LIMITED
The Exchange Building, Mount Stuart Square,
Cardiff, South Glamorgan, CF1 6EA, U.K.
Tel: (0222) 493321; Fax: (0222) 471865
Tlx: 94011989 = ECOL G

Fortel Incorporated

FORTEL Incorporated is a manufacturer of capital equipment for professional video production and post-production. The company's offices and manufacturing facilities are located in Norcross, Georgia, a suburb of Atlanta. At this location approximately 100 professional and manufacturing employees are engaged in product design development, marketing and manufacturing.

History

The company was founded in 1973 by Virgil L. Lowe. From the beginning through Mr. Lowe's engineering talents, Fortel achieved a reputation for innovative designs which made high performance affordable.

The company's initial product line was a series of Time Base Correctors for cost-effective, high-quality processing of playback signals from video tape recorders. The company's innovations have included:

- ☐ The first use of CCD devices for time base correction to provide high quality processing at a very reasonable price;
- ☐ The first Time Base Corrector to employ DUB output from ¾-inch recorders to avoid the picture degradation associated with the record and playback process;
- ☐ The first single-board, Type C Time Base Corrector, featuring superior performance at substantially lower cost than competing units;
- ☐ The first popularly priced 6-vector color correction system.

Fortel has also introduced many advances in picture processing through products which include superior image enhancement, chroma noise reduction, and color correction products. Among these products are the ColorEX Chroma Noise Reduction System and the Y-688 Total Error Corrector, which features advanced picture enhancement and noise reduction techniques.

In 1984, Fortel extended its product development activity to Digital Video Signal Processing. Chosen by General Electric Company as a supplier for their COMBAND Project, Fortel, in nine months, developed and delivered head-end equipment which combines two NTSC signals into a single 6 MHz cable TV channel. The COMBAND development required extensive use of advanced digital processing of video signals in a component environment.

Market and Products

The company will offer this technology both in the form of proprietary products and OEM agreements. Proprietary products include a growing line of video processing equipment, including time base correctors for M, C, and ¾-inch formats, and a family of Color Correctors for use in video production and post production applications. Fortel intends to continue to expand this line with emphasis on products which exploit digital implementations of component video processing. Fortel's objective is to become a major supplier of high-quality, component video processing equipment and sub-systems for the video production industry.

The company also intends to develop an OEM business activity which seeks attractive outlets for custom designs, which exploit Fortel's key technologies ... digital component video processing, high-performance video servo technology and high-speed digital signal processing software. The company offers innovative, cost-effective design, rapid response and flexible contractual relationships (manufacturing, licensing, etc.). The company supports this activity with an excellent CAE/CAD/CAM network which ensures fast design turn around and good design and documentation quality.

Fortel sells its products in the US and Canada through a network of professional video dealers supported by four Regional Sales Managers. Distribution is limited to dealerships which meet high standards for professionalism, service and quality.

The company has recently established an overseas dealer network, with outlets in most Western European countries, Japan, Korea, Australia, New Zealand and Southeast Asia, and the Middle East. Nigel Spratling, European Sales Manager, has a Fortel office in London, England. ☐

Fortel Incorporated
2985 Gateway Drive
Norcross
Georgia 30071
USA
Tel: 404-449-4343. Tx: 804 4822.

FORTEL'S AFFORDABLE NEW TURBO 2 TBC. PEAK PERFORMANCE AT ANY SPEED.

From freeze to shuttle. Now you can get Y-688 performance from an affordable signal processor — with Fortel's new TURBO 2 Time Base Corrector. Slim-lined and feature packed, TURBO 2 is the first in a new generation of Fortel products — products designed to give you peak performance in signal processing.

No other TBC gives you so many features. Features like Y-688 component processing, field freeze, frame freeze, high speed shuttle and dynamic tracking, all at CCIR-601 sampling. TURBO 2 also gives you luma noise reduction, horizontal enhancement, drop-out compensation and switcher compatible Y/R-Y/B-Y outputs — features you would normally expect from our Y-688 T.E.C.

Fortel's new TURBO 2 is built for serviceability. Interchangable PC boards in a 1¾ inch rack space make troubleshooting a breeze.

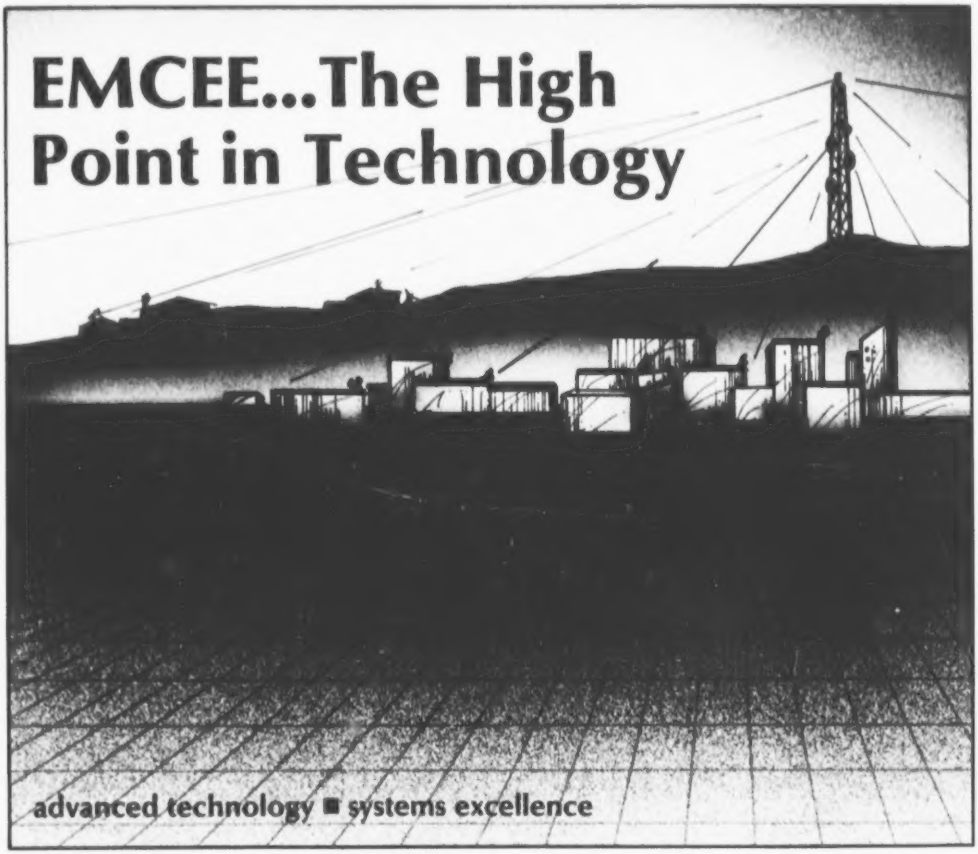
It's the signal processor you can depend on for the long run.

TURBO

The new industry standard

FORTEL

FORTEL Incorporated
2985 Gateway Drive
Norcross, Georgia 30071
1-800-241-5046
In Georgia 404-447-1122


EMCEE...The High Point in Technology
advanced technology ■ systems excellence

For the past 26 years EMCEE has supplied television transmitters and translators to a growing world market. Today this equipment can be found in over 70 countries. The product line includes VHF and UHF from 1 Watt to 5000 Watts and specialized microwave equipment at 2GHz to 2.7GHz up to 100 Watts. EMCEE is also a turnkey house offering design, supply, installation and commissioning of complete transmission/reception systems.

The VHF and UHF line is used to extend the coverage of commercial TV systems and for the local distribution of Satellite signals. The microwave equipment has been used for years by educators for instructional TV systems called ITFS and is in use at most large universities in the USA today. Data can also be transmitted with this equipment and several news services around the world have installed large networks with EMCEE transmitters. Recently this equipment has been used for multichannel subscription television called MMDS. MMDS systems can be installed at a fraction of the cost and in much less time than conventional cable systems and will provide multiple channels of programming over the air to the subscriber's home.

All EMCEE products are made to the highest standards. The equipment is often placed in unattended sites under harsh environmental conditions and still must deliver broadcast quality signals. Such demands have molded the EMCEE design philosophy into one that emphasizes quality and reliability.

EMCEE services are equally impressive providing site surveys, path analysis, equipment selection, installation, testing and training all done with in-house personnel. There is also a worldwide network of dealer/representatives to provide local service in many countries.

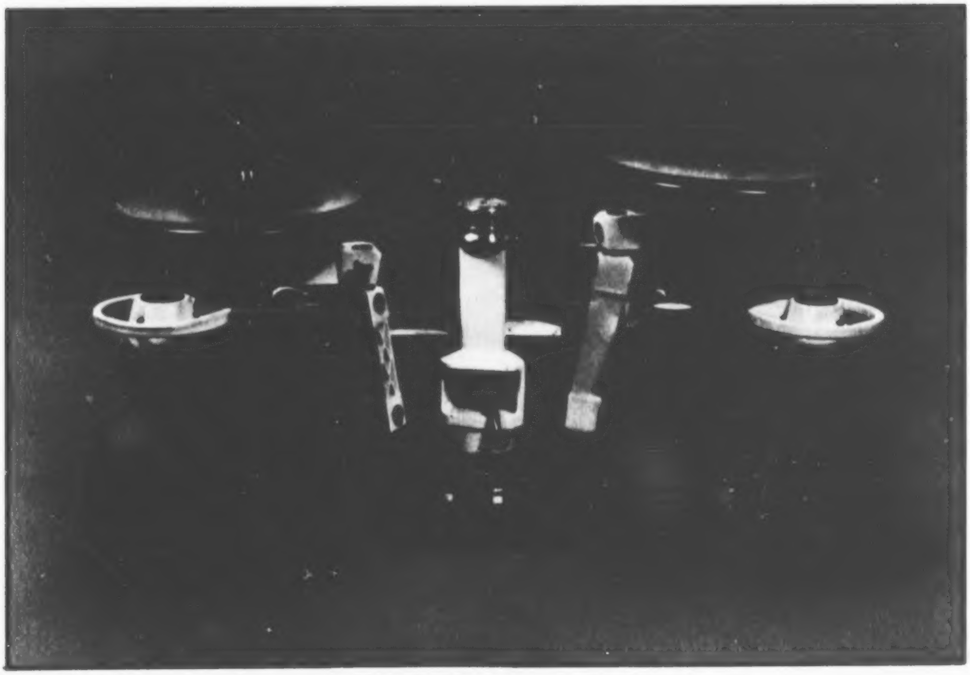
Whether your needs are for commercial broadcasting, education, or pay TV systems, contact EMCEE and let them put their quality and experience to work for you. For complete information contact:

EMCEE Broadcast Products
P.O. Box 68
White Haven, PA 18661
USA
Telephone: 717-443-9575
TWX: 510-655-7088 ans. EMCEE WHHV

System Performance Responsibility

Your single source for television transmitters, translators, antennas, towers, cable, engineering and installation.

EMCEE



CINERENT AG

The Rental Company

The Cinerent Filmequipment Service AG, located in Zürich, Switzerland, was founded in 1978 by cameraman Peter Hürlimann. Thanks to the high level of quality expected by Peter Hürlimann, the rental company has become the leading firm of its kind in Switzerland. As a result of these high standards, today Cinerent is increasingly catering to an international clientele. Furthermore, Cinerent has specialized in adapting equipment for extreme conditions, for example: when filming in cold regions like Alaska, Greenland and the North Pole, where temperatures fall to around −60°C.

Because the continuous aim of Cinerent as a rental company was to supply its demanding customers with optimal equipment, it soon began developing new products, especially in the field of Grip-Equipment (camera-crane, camera-dolly), where the palette of existing products was unsatisfactory.

As the available equipment could not meet emerging requirements (ENG, Videostudios) Cinerent embarked on improving market products to ensure that they are:

☐ lightweight
☐ of low volume for transportation
☐ universal in range of application
☐ easy to operate
☐ maintenance free

The Manufacturing Company

'Cinejib': The design of the camera-crane 'Cinejib' is based on a unit-type construction. Thanks to its modular construction, the 'Cinejib' can be assembled and operated by just one person. Furthermore, the 'Cinejib' offers the possibility for a wide range of application in difficult settings. The maximum height attainable during operation is 4.5 meters and the lowest level is 30 centimeters below ground level. The heaviest component (arm) weighs merely 50 kilograms.

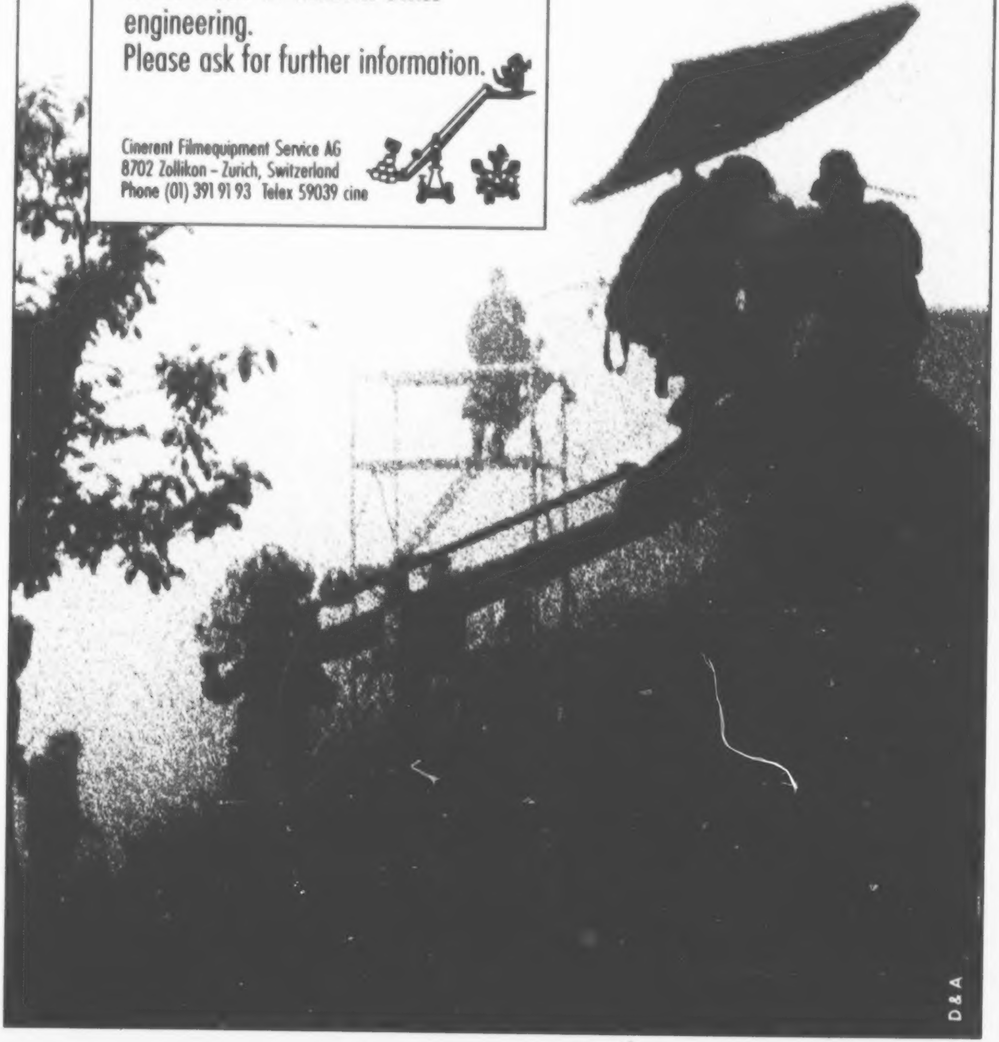
'Hotdog': The 'Hotdog' has been designed especially for the camera-crane 'Cinejib'. The 'Hotdog' is not only the optimal base for the 'Cinejib', but also a low cost and versatile 'all round' dolly. With its easily exchangeable wheels (combined-wheels, balloon-wheels) the dolly can be used in the studio, on tracks as well as on uneven ground.

'Swissdolly': The 'Swissdolly', pictured above, is the world's most compact and versatile dolly. The unique, lightweight, unit-type construction allows for the widest range of applications in film and video. The 'Swissdolly' is fully compatible with the 'Cinejib'- and 'Hotdog'- programs and also provides the possibility for mounting a special video-lift or a programable high-tech-lift with a payload of 250 kilograms. ☐

Cinejib makes the Take go 'round

Cinejib is a unique light-weight crane-system. The unit-type construction enables quick and easy assembly, dismantling and transportation in a small vehicle. **Cinejib** is the result of modern Swiss engineering.
Please ask for further information.

Cinerent Filmequipment Service AG
8702 Zollikon – Zurich, Switzerland
Phone (01) 391 91 93 Telex 59039 cine



Here's what three decades of innovation can mean to your communications needs.

Investment in communications—an essential ingredient of global trade and economic expansion—calls upon the Farinon Division of the Harris Corporation* for its state-of-the-art microwave and lightwave transmission products. Products that can be found working in more than 100 countries and backed by a 2 billion dollar corporation committed to service and support. From system definition to complete turnkey installation, Harris Farinon offers solutions for virtually any telecommunications requirement anywhere in the world.

Technology Leaders

Since its founding three decades ago, Harris Farinon has been dedicated to designing and manufacturing reliable products to help its customers solve their communications needs and better control their costs. Today, Harris Farinon is one of the recognized leaders in the application of up-to-date technology for the development of microwave and lightwave transmission products.

For example, in digital radio, the company pioneered the development of efficient modulation techniques in its equipment line some twelve years ago, and today supplies 24 different digital microwave radios in bands from 1 GHz to 23 GHz, with capacities ranging from 2 to 34 Mb/s.

The company has dedicated and highly motivated marketing and development teams who coordinate their activities towards determining customer needs in changing technological environments and developing appropriate products needed for the marketplace.

Industry's Broadest Equipment Line

The company's microwave and lightwave products are produced to North American CCIR, CCITT and CEPT standards. Harris Farinon emphasizes new product development of reliable, easily maintainable hardware, introducing several new and improved products each year.

Harris Farinon's microwave radio line is by far the most comprehensive of any supplier anywhere in the world. More than 40 types of radio systems in frequency bands from 225 MHz to 23 GHz are currently produced, representing the industry's broadest line. Lightwave systems, multiplexers and other ancillary equipment round out Harris Farinon's full spectrum of products.

A primary advantage to the Harris Farinon customer is significant economy realized in working with a single-source, highly professional supplier who can adapt equipment to meet the specific requirement rather than remolding requirements to fit the equipment.

Additionally, Harris Farinon has vast experience in solving communications challenges on the broadest range of projects throughout the world, and makes this knowledge work for the customer.

Total Service Capability

To become established as a leader in the field of telecommunications takes more than the ability to produce a broad range of sophisticated, advanced transmission equipment. It requires a thorough understanding of the special needs of the customer, and the specific dynamics of each industry's communications environment.

Harris Farinon places great emphasis on offering total system capability to its global customers. Over the years the company has brought together a group of highly experienced professionals who can take care of everything—from initial concept microwave radio path survey, system engineering, furnishing its own and vendor equipment, installation, testing, commissioning and maintenance.

Harris Farinon has constructed both small and large communications systems in every possible environment in more than 100 countries. Beginning with the initial concept and continuing to in-service operation, Harris Farinon has always undertaken total responsibility, where needed, with a steadfast commitment to satisfy completely all requirements, whatever it takes. The company's measurement of success is aptly represented by the large number of customers who continually rely upon its products and services, and the new and growing customer base that has developed throughout the years.

Harris Farinon's operational headquarters is based in San Carlos, California. The company has manufacturing facilities located at San Carlos, California; San Antonio, Texas; and Dorval, Quebec, Canada. It runs its own independent development, engineering, production facilities and field services and is responsible for all activities required to satisfy the needs of its global customers.

*The Harris Corporation is a $2.2 billion producer of advanced information processing, communications and microelectronic products. The company's products, systems, networks and components—which are used to process and communicate data, voice, text and video information—are sold in more than 100 nations of the world. Harris is headquartered in Melbourne, Florida, employs 27,000 people and has 35 plants in the U.S., Canada, Europe and Asia.

Remote Control.

This is the remote Kaziranga Forest in India. And it's no place for second guessing or second best.

Which is why we're out here with the oil and gas companies of India. We're the people who put their communications package together, and by using our LR4 line of digital microwave radios, superior and reliable performance is taken for granted, day in and day out.

Performance that's working in 140 countries, and backed by a 2 billion dollar corporation committed to service and support. Performance that can extend, overbuild or replace existing analog radio using similar bandwidths.

You have ultimate control by picking and choosing the right product for the job. Right-of-way companies from Venezuela to China use our range of frequency bands and capacities for system flexibility and cost control efficiency.

And they depend on our optional customer support program that includes system design, program management, installation, field service, customer training and repair and return.

So when you're ready to make your remote stations a little less so, and need digital microwave radio systems that work no matter where you work, call Harris Farinon at (415) 594-3319, TELEX 34-8491 or write 1691 Bayport Avenue, San Carlos, CA 94070 U.S.A.

Or simply drop by a jungle outpost nearest you and ask about our LR4 line of products.

HARRIS
FARINON DIVISION

More than 30 years of professional technology for Radio and Television Broadcasting

YEAR 1957
1 W TV TRANSPOSER

TV BROADCASTING

TELEVISION TRANSPOSERS AND TRANSMITTERS

- Operation according to CCIR B/G system
- Dual sound IF modulator equipped with SAW filter (in oven)
- Synthesized local oscillators, precision offset operation
- Common amplification of vision-sound carriers
- Solid state wideband amplifiers (up to 1 kW)

TELEVISION RELAY RECEIVERS AND MEASURING DEMODULATORS

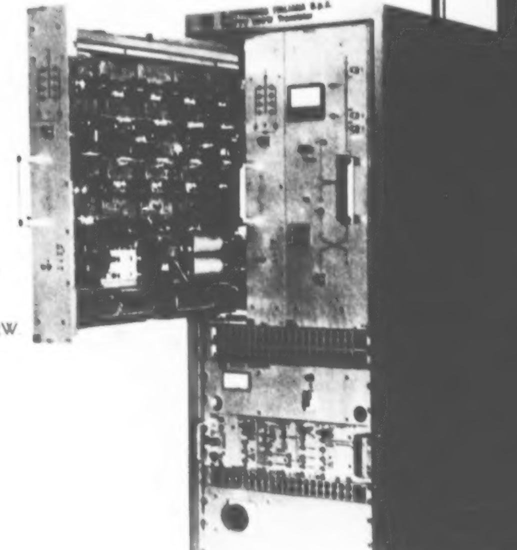
SIDEBAND ANALYZER "AMPLIGROUP"
FOR AMPLITUDE - GROUP DELAY - INTERMODULATION TESTS
ON TV TRANSMITTERS AND TRANSPOSERS

VHF - FM RADIO BROADCASTING

TRANSPOSERS AND TRANSMITTERS

- Direct transposition between input and output channel or through demodulation and re-modulation processes
- Exciters equipped with high quality Stereocoder
- Wide range of solid state Broadband Amplifiers from 100W to 5 kW
- 10 kW tube amplifier

RELAY RECEIVERS AND MEASURING DEMODULATORS



YEAR 1987
500 W TV TRANSPOSER

ELIT
ELETTRONICA
ITALIANA s.p.a.

20151 MILANO - ITALY - VIA GADAMES 100
TELEX 331198 ELIT - TELEFAX (+39.2) 3011136

Electro-Voice TL Series vented enclosures incorporate DLX low-frequency transducers which supply very high efficiency and exceptional power handling capacity.

Constant-Directivity Speaker Systems, Full-Range Systems

Electro-Voice has also engineered and manufactured full-range systems and speakers. FR15-2 and FR12-2 two-way, full-range, constant-directivity speaker systems provide well-defined coverage angles and rugged dependability for venues in which the complexity of component systems is not required.

The PI Series of integrated systems features wide-angle, wide-range products with moderately high efficiency. Their applications include systems where the directivity control, higher efficiency and the complexity of a component-based point source, or cluster, is not required.

In Concert With Manifold Technology™

Electro-Voice is committed to producing only the finest products for high-level concert sound reinforcement. Our trend-setting technology has resulted in the MT-4 Manifold Technology™ system.

When EV engineers reviewed today's concert systems, they found serious problems with enclosure size and sound quality that demanded radical, new solutions. They solved these problems with the MT-4, a two-box system (the MTH-4 high-frequency box and the MTL-4 low-frequency box) which produces twice the output of conventional systems in half the space.

Manifold Technology enables Electro-Voice to combine the output of multiple drivers without dips or peaks in frequency response. This high-efficiency design delivers tremendous sound pressure, minimum distortion and constant coverage with smaller frontal areas than conventional concert systems.

Professional Microphones

Electro-Voice produced microphones as our first product line in the 1920's. The early EV 600 series quickly gained a reputation for being "tough enough to hammer in nails" and still perform to specifications. In 1963, we were given an award for technical achievement by the Academy of Motion Picture Arts and Sciences for our model 642 Cardiline mic.

We have been a part of America's space program since its inception, supplying microphones for the Mercury and Gemini space missions as well as NASA's Skylab program. The rugged dependability of our military and space products extends to every microphone in our line.

From small business meetings to giant concerts and stadiums in some of the most remote areas of the world, EV mics are performance proven for quality sound reinforcement and durability.

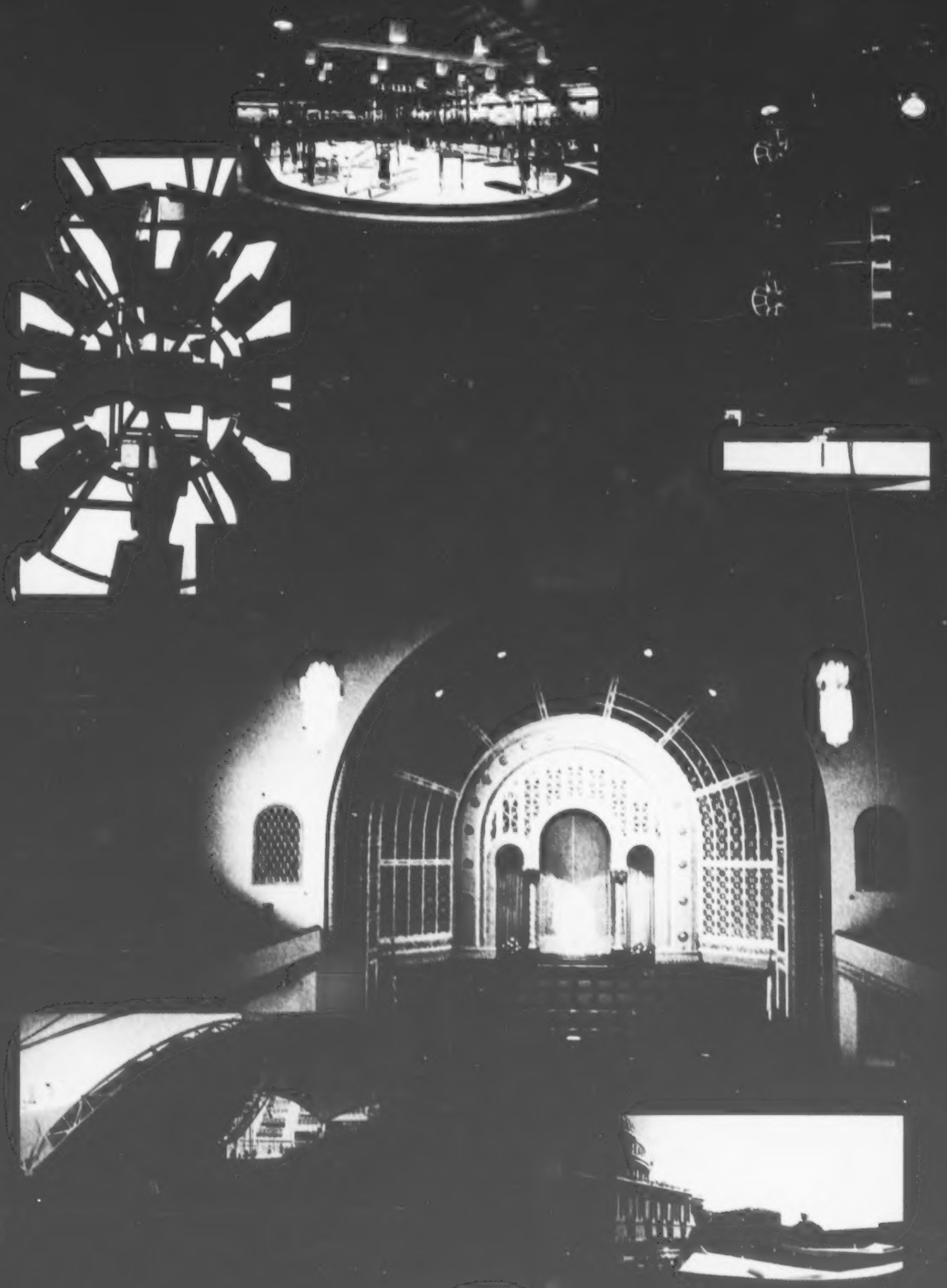
The EV Commitment

Electro-Voice continues to enhance its 60 year commitment to the pro sound reinforcement industry. Nearly 15 years ago, we began a total reevaluation of available components with an eye toward improving performance with fresh engineering ideas and the advantage of the latest materials and manufacturing technology. We became the first manufacturer to systematically attack performance compromises in high-frequency horns, compression drivers and low-frequency systems. The results of our efforts can be heard in the quality performance of every EV pro sound system. We are Sound in Action.

Detailed product information and publications are available by contacting Electro-Voice, 600 Cecil St., Buchanan, MI 49107. TWX: 810/270-3135. FAX: 616/695-1304.

EV® Electro-Voice®
SOUND IN ACTION™

...Excitement In Sound



Internationally Acclaimed Professional Sound Products

Electro-Voice

MARK IV

Electro-Voice®
SOUND IN ACTION™

Electro-Voice has built its 60 year reputation as the leader in professional sound reinforcement products by finding solutions to the problems faced by audio professionals. The "Pro Sound" products we manufacture today are the result of trend-setting technology whose success is measured through international customer satisfaction. By staying in concert with the marketplace. Electro-Voice has mastered the art of producing products recognized for their toughness, quality and durability in the world's most demanding applications.

EV Pro Sound Products

Electro-Voice manufactures precision crafted products to satisfy many of the needs in pro sound applications. Typical fixed installation sound systems include stadium, arenas, performing arts centers, theaters, churches, gymnasiums, auditoriums, ballrooms, clubs, discos and amusement parks.

When EV professional sound reinforcement components first appeared in 1975, they were immediately recognized as a fundamental contribution to the art by prominent acoustic consultants. Major systems were specified *without allowable alternatives*. Today Electro-Voice professional sound components are in use in installations both large and small throughout the world.

Innovative designs originated by Electro-Voice engineers have produced over 160 patents. These patents include many fundamental contributions to the state-of-the-art such as the Variable-D cardioid microphone and the constant-directivity high-frequency horn.

EV's design experience in pro sound has also led to technological advances in concert loudspeaker systems. Our new MT-4 uses half the space to double the output of conventional touring systems, reinforcing the dynamic excitement of concert music with undistorted, high-level sound.

Constant-Directivity HP Horns

Electro-Voice introduced the world's first constant-directivity horn in 1974. This innovation produced a horn which, for the first time, provided truly uniform coverage angles over a wide frequency range.

Now Electro-Voice has developed a second-generation constant-directivity design: the HP TransPlanar™ high-frequency horn incorporates a patented blend of flared and conical surfaces, the precision of directivity-optimized size and unique beamwidth control vanes to deliver the most uniform bandwidth control in the industry.

High Performance Drivers

Only EV offers the finest 500-Hz crossover driver on the market. Coupled to an HP horn, the DH1A provides more high-frequency output than any other 500-Hz driver. More musical depth. More articulate, natural voice quality. And better transient attack than anyone ever imagined from a compression driver. The DH2 compression driver can be used with excellent results in systems that utilize an 800-Hz (or higher) crossover point. Both the DH1A and DH2 drivers have standard 2-inch exits and are compatible with any Electro-Voice HP Series horn.

The DH1A and DH2 feature titanium diaphragms for superior power capacity without sacrificing conversion efficiency even in the mid-band. These maximum efficiency designs minimize amplifier power requirements and maximize driver reliability.

Low-Frequency Systems

Electro-Voice was the first to practically apply the advanced analyses of optimally vented woofer/enclosure combinations of Australian researchers A.N. Thiele and Dr. R.H. Small. This technology extends the system's low-frequency limit by approximately one-third of an octave without substantially reducing the maximum output ability.

(Continued after color pages)

THE PERFECT TEAM FOR YOUR MONITORING SYSTEM

CVS CONTROL-MONITOR

Has fully guaranteed specifications, and features AKB to maintain colour temperature and black-level stability.
The CVS has automatic colour temperature alignment, built-in generators for numerous test patterns and safe-area display.
All functions are controlled from the keyboard. Operation is menu-driven, and commands and set-ups appear on the screen. Both calibrated and prefered presets can be stored and recalled.
The monitor has four slots for plug-in modules allowing use of current options or to take advantage of new developments in monitoring-technology.

BARCO
INDUSTRIES

MMRC MULTI-MONITOR-REMOTE-CONTROL

Any and or all functions can be made available at a full remote control in order to adjust a single or all monitors of a production-gallery.

CTVM 4 MASTER-CONTROL-MONITOR

Has the highest specifications possible. AKB-circuitry guarantees ultimate stability.
Provided with features such as safe-area, RGB-switches, built-in test patterns etc... the CTVM 4 is definitely the best measuring monitor available.

FOCUS ADVERTISING

Barco Video & Communications n.v. Th. Sevenslaan 106, B-8500 Kortrijk BELGIUM tel intl 32 56 23 32 11, tlx 85 842 barind b

Because you're surrounded by enemies of unknown strength.

Spikes, transients, noise, sags, and surges — they're today's electronic enemies.

L.E.A. Dynatech armors your total facility against these problems, providing the industry's highest performance power conditioning products. Our sole purpose is to provide complete "suits of armor" which protect your electrical, electronic, and data transmission equipment against attack from these unseen enemies. We will tailor a total facility protection plan for a complete facility, an individual system, or a single piece of equipment.

Founded in 1971, L.E.A. developed several patents and broadened its line with products that provide state-of-the-art protection against lightning, utility, facility, or equipment generated spikes, transients, and electronic noise. Acquired by Dynatech Corporation in 1983, a move that further strengthened our technical and financial capability to meet the challenge of providing the highest performing power conditioning equipment in the world.

Protection against the destructive blows of big lightning strikes.

Solid-state equipment, electronic systems, computers, and even complete plants can fall prey to a variety of spike, transient, and noise problems, caused by distant lightning strikes, high voltage utility switching, and other power grid problems. Moderate voltage transients are caused by neighboring facilities and equipment in your own facility. Electronic noise is virtually always present on power lines in one form or another. The basic building block of L.E.A.'s product line is the Surge Eliminator®. The Surge Eliminator's® unique "Series-Hybrid" design protects against all forms of high voltage spikes. This design uses a highly efficient series control element (SCE) to intercept and control incoming surges.

Surprisingly, most surge protectors use a much less effective "parallel" design that has no in-line control element.

The SCE reacts proportionately to surge speed and strength, which causes the high energy dissipator (HEDs) and fast acting transient energy protector (TEPs) to operate at maximum effectiveness and dissipate the worst surge harmlessly.

Frequent transients and noise disrupt and degrade.

A major surge or spike can destroy your system with a single blow. Yet there is an even more pervasive threat that is much less easy to recognize. It is the continuous series of minor blows, called transients and noise, that degrade your equipment and disrupt your operations in very subtle ways, resulting in increased downtime, higher operating costs, more frequent service calls, shorter equipment life, and lost revenue. The widespread use of solid-state microprocessor technology makes higher performance digital systems, computers, solid-state transmitters, and medical electronic devices increasingly vulnerable to the problems that plague our overtaxed power generating system.

Our Kleanline® Electronic Filtering System is designed to protect your electronic systems from all three threats . . . destructive spikes, disruptive transients and degradative noise. The Kleanline System® combines the same superior surge protection circuits of the Surge Eliminator® with two additional stages of protections: a unique sine wave tracking noise limiter (NL) for medium energy transients and a stagger-tuned, broadband, bi-directional electronic filter for lower energy EMI/RFI noise.

Kleanline® Systems protect against the majority of all power line anomalies.

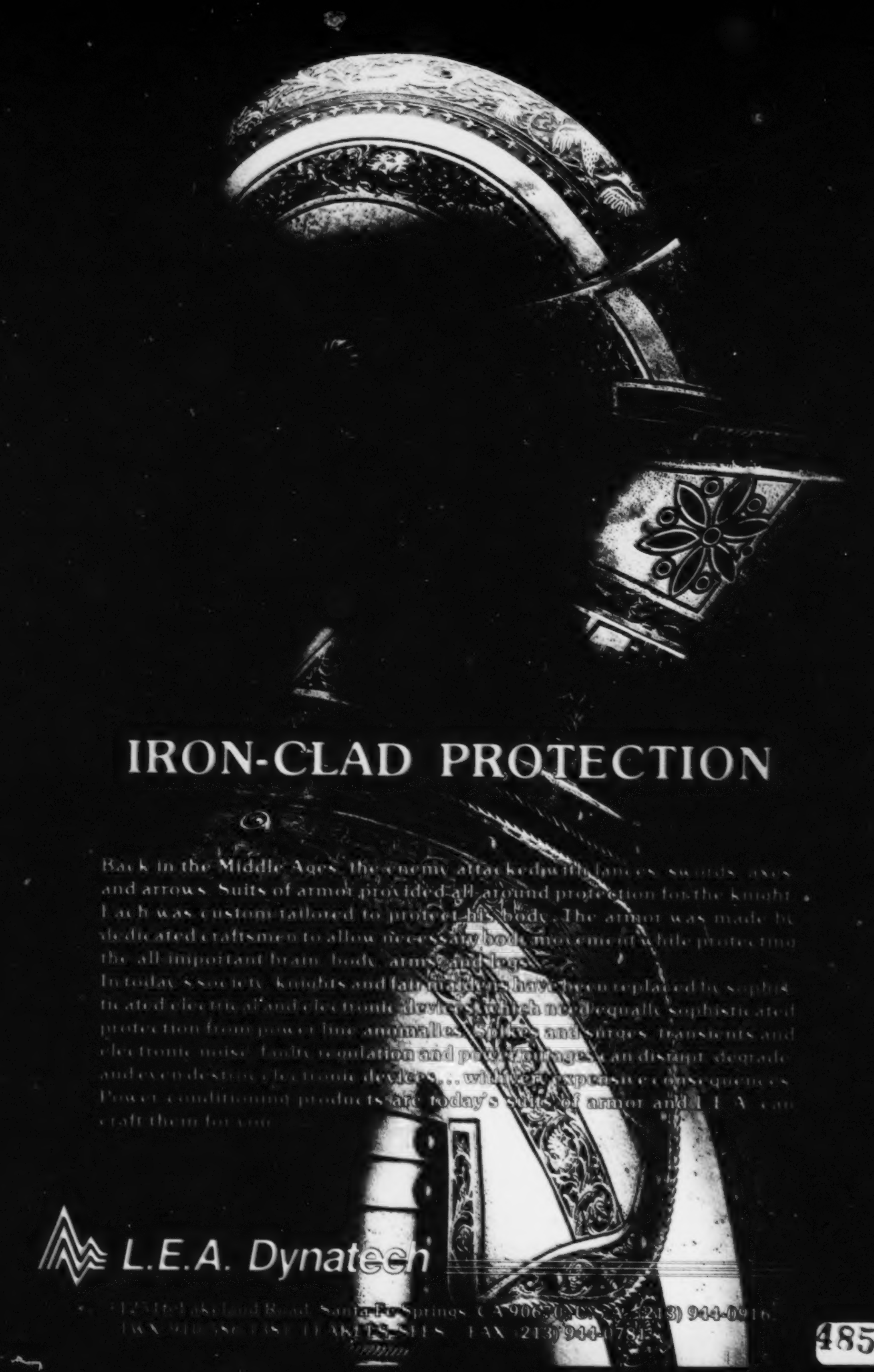
Endangered Data/Telecom links.

Data lines, RF and telecommunication circuits, security/fire systems, instrumentation loops, and process controls require protection of a slightly different kind. Digital and analog data are transmitted at very low voltages and currents, making them even more vulnerable to lightning and other electromagnetically induced anomalies. Using the "Series-Hybrid" design, L.E.A.'s Transient Eliminators® are extremely fast, and handle the highest energy spikes possible. They have extraordinarily low insertion losses and come in coaxial and intrinsically safe configurations. Because of their compact, modular design and extreme packaging flexibility, our Transient Eliminators® are the protectors of choice in many unusual and special applications.

Ironclad protection for every application.

L.E.A.'s conditioning systems are the best protection you can specify. And like the state-of-the-art craftsmen of yesterday, our experts will help you analyze your points of vulnerability and recommend the best protection methods and conditioning products for your system needs. L.E.A.'s iron-clad protection doesn't end with the industry's finest products. We make sure your satisfaction continues after the installation with our extensive service organization of experienced engineers standing by to support you with technical assistance.

So, whatever your needs, remember the iron clad protection L.E.A. offers . . . suiting up is good insurance . . . the alternative can be very expensive.



IRON-CLAD PROTECTION

Back in the Middle Ages, the enemy attacked with lances, swords, axes and arrows. Suits of armor provided all-around protection for the knight. Each was custom tailored to protect his body. The armor was made by dedicated craftsmen to allow necessary body movement while protecting the all-important brain, body, arms and legs.

In today's society, knights and fair maidens have been replaced by sophisticated electrical and electronic devices which need equally sophisticated protection from power line anomalies. Spikes and surges, transients and electronic noise, faulty regulation and power outages can disrupt, degrade and even destroy electronic devices . . . with very expensive consequences. Power conditioning products are today's suits of armor and L.E.A. can craft them for you.

L.E.A. Dynatech

12516 Lakeland Road, Santa Fe Springs, CA 90670 U.S.A. (213) 944-0916.
TWX 910-586-1381 LEAKLESS-SFES FAX (213) 944-0781

STANTON TRADITION

Stanton Magnetics was founded in 1961. Its purpose was to create and market product for the professionals in the Recording and the Broadcast Industries.

At that time, recording equipment and playback electronics had outgrown the capabilities of the best state-of-the-art cartridge designs.

To close this technical gap, one of Stanton's first major moves was to create the Calibration Standard Series of Magnetic Cartridges. Stanton resolved to produce an "absolute" cartridge standard . . . stereo cartridges of such linearity and overall quality as to gain immediate acceptance within the Recording and the Broadcasting Industries, and of so advanced in design that it would remain the standard for years to come.

Stanton's devotion to the needs of Audio Professionals has had a profound effect on listening habits around the world. Today, the majority of Stanton product goes into the systems of audiophiles for home entertainment. While Stanton Magnetics can be characterized from many points of view, perhaps the most important is the company's commitment to quality and reliability. Such goals demand total dedication to quality control and research. Our research department, the heart of the company, has a team of engineers who create and then monitor the production of a cartridge. They use sophisticated sound and measuring equipment, such as the Real Time Analyzer, which gives a precise, visual display of a cartridge's performance, and the Scanning Electron Beam Microscope to examine and study styli as well as record grooves.

Stanton's commitment to excellence is borne out by the fact that each of the twenty or more components that goes into every cartridge is manufactured within our own plants, to insure complete uniformity. In addition, and unique to our type of manufacturing process, *every* cartridge is checked against "Criteria for Standards" and not, as is often the case with other manufacturers, merely spot-checked. In the course of time, we have also developed professional related products, a Preamplifier/Equalizer, Stereo Headphones and Record Care products.

Stanton Magnetics was formed to meet the exacting needs of the audio professional and although our market has grown to include the more demanding nonprofessional audiophile, our commitment to quality is the same as was back in 1961.

Walter O. Stanton

Walter O. Stanton
President

BROADCASTING

RECORDING

THE CHOICE OF THE PROFESSIONALS™ . . .

SC4
Stanton
STYLUS CLEANING SYSTEM
STANTON
Stanton

STANTON . . . First choice of Broadcast and Recording Industries. Products that have been designed and engineered to fit the needs of the Professionals in Broadcast, Recording and Discotheques combining the highest standards of excellence in performance with the ability to stand up under heavy usage. Audiophiles are also using these products because of their excellence in their own home entertainment systems. Stanton offers a complete line of professional products including cartridges, styli (including LP & 78RPM styli) preamps, headphones, earphones and record care products.

STANTON
THE CHOICE OF THE PROFESSIONALS™

For further information contact Stanton Magnetics Inc.
Dept. FC 200 Terminal Dr., Plainview, NY. USA 11803

GLOBAL SUPPORT FOR GLOBAL COMMUNICATIONS

SCOPE This summary is intended to familiarize the reader with the background, current status, and future programming of MCL, Inc., Manufacturers of TWT and Klystron Amplifiers and other products for Satellite communications. MCL provides a 24-hour sales and technical support for immediate service worldwide.

BACKGROUND INFORMATION MCL was founded in 1961 as a design and manufacturing organization specializing in coaxial and waveguide components. The company was founded by three people, with Robert E. Morgan, holding in excess of 80% of the privately held stock. The company name at this time was known as Microwave Cavity Laboratories, Inc. MCL quickly transitioned from coaxial and waveguide components into active microwave tube devices for various emerging U.S. military programs. Mr. Morgan is Chief Executive Officer and sole proprietor and renamed the company MCL, Inc. in 1973. No changes in location and/or personnel were made other than normal personnel changes, as expected in the elctronics industry.

PHYSICAL FACILITIES MCL, Inc, now operates from a new, specially-designed modern, two-story building built in 1986 to provide the utmost efficiency in production. Located in Bolingbrook, Illinois, the plant occupies approximately 59,000 square feet of useful floor space. MCL is located approximately 40 miles southwest of the downtown Chicago Loop area. Total personnel at the present time is approximately 110 of which 25 - 30% is engineering personnel. All products manufactured by MCL are of MCL design.

MCL is completely equipped with modern microwave and RF test equipment, modern assembly facilities, and a machine/fabrication shop. In addition, locating in a suburb of Chicago provides MCL with access to many machining fabrication vendor facilities, and a major U.S. transportational distribution point.

MCL EXPERIENCE MCL is currently a major manufacturer and designer in the following areas:
1. Satellite communication amplifiers. In this category, MCL works from 50W to greater than 3000W CW minimum in frequency bands of 5.9-6.4, 7.9-8.4, 14.0-14.5, 17.3-18.GHz, and the new emerging millimeter band. MCL earth station amplifiers (now more than 1,000) are currently located and in service in the United States, Mexico, Europe, Taiwan, Phillipines, Alaska, Chile, England, Canada, France, Peoples Republic of China, Nigeria, Puerto Rico, Saudi Arabia, Brazil, Indonesia, Norway, Iceland, Gabon, Lebanon, Australia, etc.

2. *Airborne TWT Amplifiers*. MCL has an on going internally funded program for the development of airborne ECM type TWT amplifier power supply technology. In this technology, the requirements of size, weight and efficiency are much more stringent than those amplifiers and power supplies required for satellite communications amplifiers. In this category, there is an increasing level of MCL participation in critical government defense programs which include the following: • CW Jammer • Cracker (Israel) • Siam • F15 Test Sets (Systron Donner) • Compass Sail

3. *Coaxial cavities and high power systems*. MCL currently has 25% of its sales volume involved with special designs employing military and/or space technology. All MCL designs are predicated upon military environment and/or space environment philosophy. Power levels involved range from 10W to greater than 500,000W and cover the frequency range from 10MHz to beyond 18GHz. MCL, as a facility, and its key personnel carry a "Secret" clearance for involvement in some of the classified military programs in which MCL has participated. MCL has equipped itself to do its own transformer construction, high vacuum potting and impregnation, and other unique technologies in which MCL is involved.

4. *Catalog items*. MCL has a line of proprietary products which include high power RF signal generators, high power 1kW amplifiers, and instrumentation type TWTA's and Klystron amplifiers.

MCL, like many companies, has changed its major thrust within the last few years. An analysis of this volume, which will reach fifteen million dollars in 1987, is indicative of the restructuring of MCL's product line to meet the changing marketplace. Currently, approximately half of MCL's sales volume is directly related to satellite communication transmitters in all of the applicable satellite communication frequency ranges. Basing this product line on good, solid design concepts, MCL has secured in excess of 40% of all the ongoing domestic United States earth station transmitter applications. MCL continues to enlarge its market share in this area by constantly improving the existing product line and adapting it to meet current customer requirements, including the recent introduction of computer-compatible earth station transmitters. As mentioned previously, airborne ECM TWT power supplies is also a very active product line in the MCL spectrum, and will be accounting for good future sales growth as many of these pilot military programs transition to a production basis. Finally, specialized, very high power transmitters/amplifiers continue to be of interest to MCL, and as such, since MCL is one of the few companies left in the domestic United States who can participate in programs of this type, remains a very active engineering area in the company, and consistently represents a stable percentage of MCL's sales volume.

MCL is committed to customer satisfaction and its people are dedicated to quality and service, which account for consistently high rate of repeat business which MCL captures. MCL pledges to continue to push the state-of-the-art microwave transmitters/amplifiers forward in the most intelligent fashion, while never compromising upon the needs of their customers.

SERVICE MCL maintains a 24-hour, seven-day a week telephone hot-line capability and a field service department for customer support. Trained personnel are available for your support.

MCL

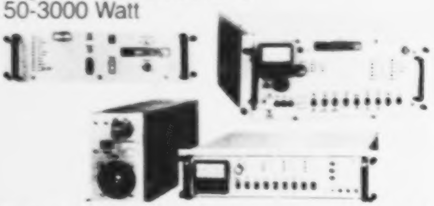
MCL, Inc. 501 S. Woodcreek Road • Bolingbrook, IL 60439-4999 U.S.A. • 312-759-9500
TWX 910-683-1899 • FAX 312-759-5018

Manufacturers of TWT and Klystron Amplifiers for Satellite Communications
24-Hour Sales and Technical Support for Immediate Service Worldwide

GLOBAL SUPPORT FOR GLOBAL COMMUNICATIONS

C-Band and Ku-Band High Power TWT Amplifier Systems

For Video, Voice and
Digital Communications
50-3000 Watt

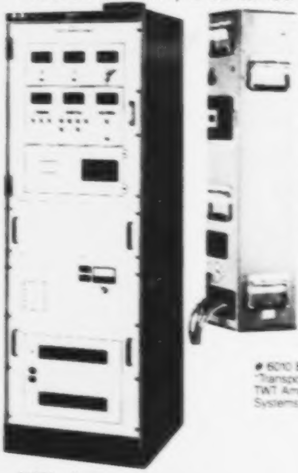


To meet expanding needs of the video, voice and data markets, MCL offers a host of C-Band and Ku-Band High Power TWT Amplifier Systems, 50-3000 Watt, with flexibility in configuration and consistently reliable power output. They are designed to withstand interference from EMI-radiation/RFF susceptibility, electrical (power source), mechanical stress, environment (temperature/humidity), or general maintenance and transportation.

TWTA C-Band 3KW Model 10717

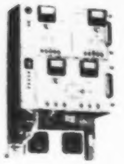
Model 10717 TWTA represents a major milestone in the development of 3kW C-Band TWT Satcom Amplifiers; combines state-of-the-art travelling wave tube technology with state-of-the-art power supply design.

The 10717 (specifically designed for the T-CSF Brazed-Helix TWT) is contained in a single rack-type enclosure for simplified operation and maintenance, along with easier and less costly integration into earth station shelters.



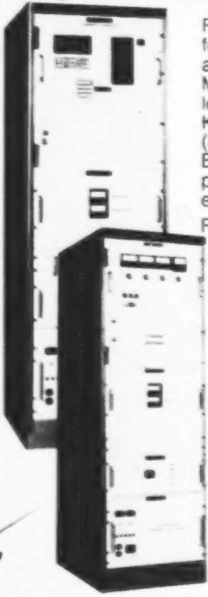
The savings on size and power efficiency are passed on to the system and ultimately the user.

Ku-Band Special Application TWT Amplifier Systems



Tested, tried and proven by communications experts worldwide, MCL's Ku-Band Special Application TWT Amplifier Systems meet - and exceed industry requirements for reliable performance under all conditions. Advanced technical design and superior mechanical layout allow MCL equipment to operate effectively even in the most extreme cases.

Microprocessor Controlled Klystron High Power Amplifiers



Field-proven and recognized for wide spectrum coverage and consistent, reliable output, MCL's Microprocessor Controlled (and Standard Logic) Klystron High Power Amplifiers (SATCOM C-Band and Ku-Band) are accepted and proven by communications experts worldwide.

Feature a host of standard equipment and options.

Klystron High Power Amplifiers Series 10000

- SATCOM
  - C-Band
  - Ku-Band
  - DBS
- Instrumentation
  - 1.5 GHz to 20GHz

MCL is a primary source of amplifiers and allied equipment for satellite communications worldwide. Commonality in operation, design, and mechanical layout of all MCL equipment provides for interchangeability and keeps maintenance and repair time at a minimum, performance at a maximum.

MCL

6010 Brochure "Transportable TWT Amplifier Systems"

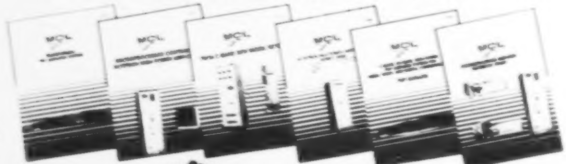
1001 Brochure "Micro Processor Controlled Klystron High Power Amplifier"

8702 Brochure "TWTA C-BAND 3KW Model 10717" 21st Century TWTA SATCOM TECHNOLOGY

9009 Brochure "Klystron High Power Amplifiers Series 1000"

6008 Brochure "C, Ku and DBS High Power TWT Amplifiers & Systems"

8703 Communications Amplifiers Reference Chart



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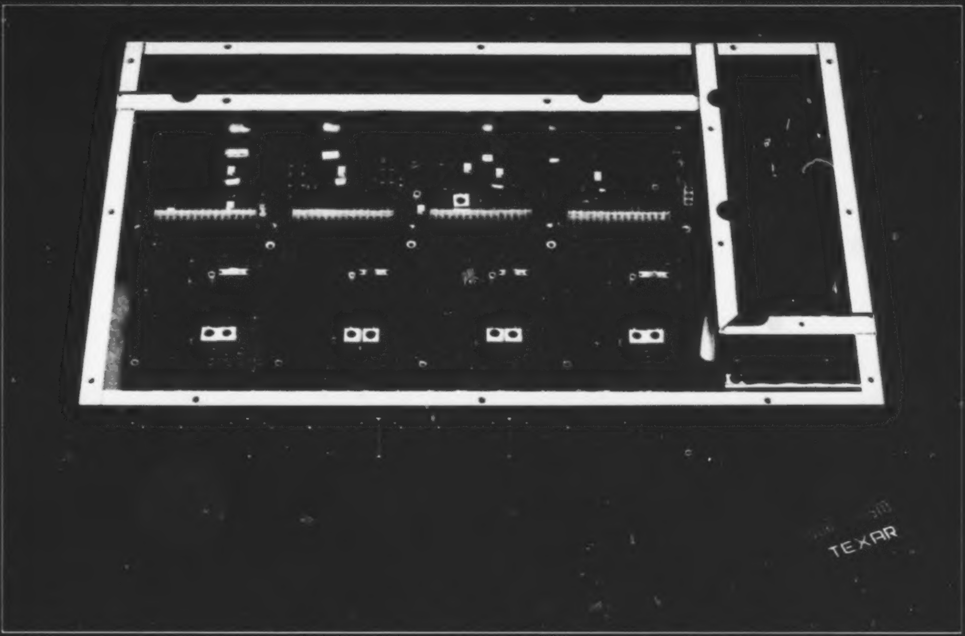


Maximizing the number of potential listeners for your broadcast facility requires maintaining a consistently high modulation level. This is true whether your service is domestic broadcast and your intended listener is in your own city, or if your service is international shortwave and the intended listener is thousands of miles away. More modulation power on your signal means greater ability to overcome atmospheric noise, local man-made electrical noise, and interfacing signals from other broadcast stations.

Modern audio processing systems permit maintaining average peak modulation levels of 95%. A station which uses older processing equipment and settles for 80% average peak modulation gives up 1.49 dB of modulation power — the equivalent of a 100 kilowatt AM station reducing carrier power to 71 kilowatts, or a 1 kilowatt station reducing power to 710 watts.

Don't settle for a smaller coverage area than you're entitled to! TEXAR Incorporated manufactures a complete line of state-of-the-art audio processing equipment for both AM and FM broadcast. Already in use by broadcasters on five continents, TEXAR processing equipment employs advanced CMOS digital control to maintain consistently high modulation levels without sacrificing the quality of the program material. (Most other audio processors employ the older ANALOG control circuits.) TEXAR audio processing is loud and clean.

The digitally-controlled TEXAR AUDIO PRISM™ (shown above with the cover removed) is the heart of the TEXAR product line. Easy to install and adjust, the AUDIO PRISM complies with the EBU Standard and is used by Radio Luxembourg. All TEXAR AM products include non-ringing, low-pass filters for user-specified cutoff frequencies of between 4.5 kHz and 10 kHz.

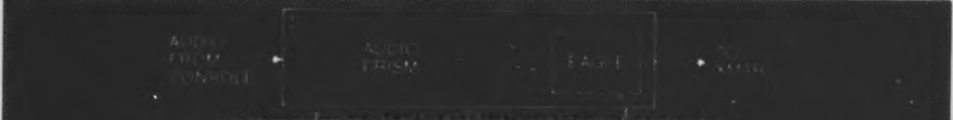
Designed to work reliably in the harshest real-world environments, all TEXAR broadcast products employ an effective, three-stage RFI and EMP suppression circuit, and have been used in transmitter plants up to 2 megawatts. Modular construction (plug-in circuit boards) makes TEXAR products easy to maintain "on-site." A simple set-up circuit makes it possible for group operators to exactly duplicate a desired air sound in all their stations.

TEXAR documentation is thorough and informative, including practical experience from the field and clear computer generated schematics. TEXAR manuals are available separately for purchase to aid in equipment selection.

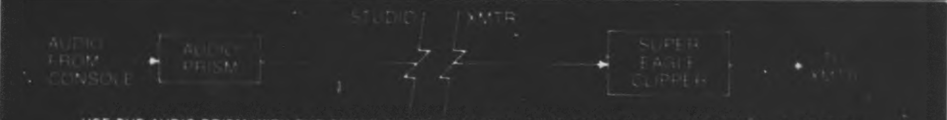
Compare performance. Compare quality of construction. We think you'll agree, TEXAR audio processing equipment is the finest available at any price. For our informative six-page brochure and the name of the TEXAR distributor in your country, write or phone Sales Manager Barry Honel.

TEXAR engineers use the latest computer design techniques to produce state of the art performance.

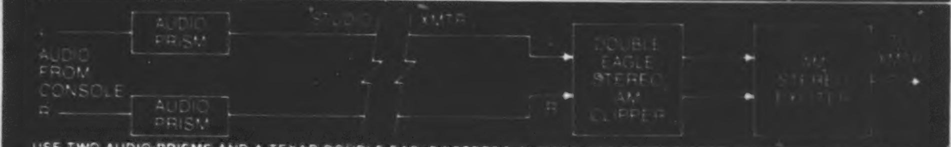
RECOMMENDED AM CONFIGURATIONS


AUDIO FROM CONSOLE
AUDIO PRISM
EAGLE
TO XMTR

FOR SINGLE SITE MONAURAL OPERATION ORDER THE TEXAR PHOENIX
AN AUDIO PRISM WITH INTERNAL EAGLE™ CLIPPER INSTALLED

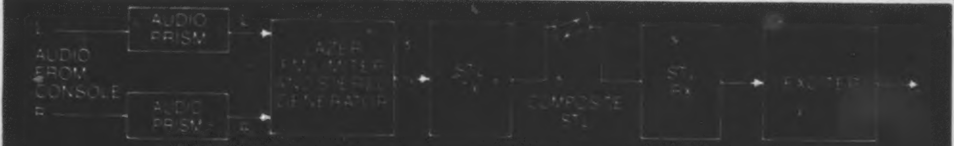

STUDIO
XMTR
AUDIO FROM CONSOLE
AUDIO PRISM
SUPER EAGLE CLIPPER
TO XMTR

USE THE AUDIO PRISM WITH THE TEXAR SUPER EAGLE™ CLIPPER FOR SPLIT-SITE MONAURAL OPERATION

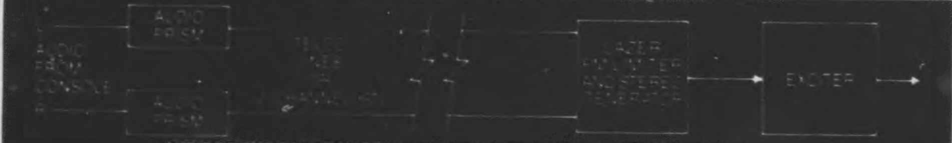

L
AUDIO FROM CONSOLE
R
AUDIO PRISM
AUDIO PRISM
STUDIO
XMTR
L
R
DOUBLE EAGLE STEREO AM CLIPPER
AM STEREO EXCITER
TO XMTR

USE TWO AUDIO PRISMS AND A TEXAR DOUBLE EAGLE™ STEREO CLIPPER FOR STEREO OPERATION (ONE OR TWO SITE)

RECOMMENDED FM CONFIGURATIONS


L
AUDIO FROM CONSOLE
R
AUDIO PRISM
AUDIO PRISM
L
R
LAZER FM LIMITER AND STEREO GENERATOR
STL TX
COMPOSITE STL
STL RX
EXCITER

AUDIO PRISMS CONNECTED FOR USE WITH COMPOSITE STL (SUCH AS MOSLEY PC-606)


L
AUDIO FROM CONSOLE
R
AUDIO PRISM
AUDIO PRISM
TELCO LINES OR 2 CHANNEL STL
LAZER FM LIMITER AND STEREO GENERATOR
EXCITER

AUDIO PRISMS CONNECTED FOR USE WITH TELCO LINES OR 2-CHANNEL (SPLIT) STL

*THE TEXAR EAGLE SERIES OF AM CLIPPERS COMPLIES FULLY WITH THE JANUARY 10, 1987 NRSC VOLUNTARY STANDARD FOR PRE-EMPHASIS AND BANDLIMITING.

TEXAR Inc. • 616 Beatty Road • Monroeville, PA 15146-1502 U.S.A.
Telephone (412) 856-4276 • 24 hour Facsimile line (412) 856-4656 • Telex 910 240 9185

FAIRLIGHT SEES MERGE OF AUDIO AND VIDEO INTERESTS

The launch of Fairlight's Computer Video Instrument (CVI) caused an unexpected stir in the international video world in late 1984. For the first time, live video could be easily combined with digital effects and drawn video images from a small box with an ergonomic control panel. Above all, the CVI didn't cost tens of thousands of dollars.

Since that first venture into a new area of development, Fairlight has firmly committed itself for further research and development of a "family" of video products. While the CVI was primarily designed with the non-broadcast market in mind, its success in all areas from design and conceptualisation to rock clips and broadcast television made it clear that there is room for a video effects and graphics device that is designed, like all Fairlight products, for the creative user.

Flexibility

Rusty Lemorande, producer of Disney's hi-tech extravaganza, Captain EO, uses the CVI to conceptualise effects before going to film because it is immediate and so flexible that he can compare results of different effects with the greatest simplicity: "It really knocked me out that so much of what I knew in effects that had to be rented at $300 an hour could be done at home with the CVI," he said in an interview in Videography magazine.

Mr Lemorande used the CVI for colourising, for keying two images together, and generally for getting the right feel into the special effects in a rough video outline of the film. As well as its enormous range of digital video effects, the CVI can be used to draw your own images on the video screen, and to incorporate them with other images from camera or tape.

One hundred "presets" stored in the computer memory can summon pre-determined effects immediately without needing to select options from the CVI's manuals. An advanced user will create and store his or her own presets, and incorporate them into sequences of effects which can provide the illusion of animation or can simply be used to time effects to seconds and frames.

Immediacy

The CVI's immediacy has also made it a niche in the discotheque market, and, naturally, in rock clips. Of course most musicians know the name of Fairlight from the musical instruments, and when a new Fairlight product emerged for another medium which is equally important in today's music industry, they wanted to try it out. Jean-Michel Jarre, Sandi and the Sunsets and Godley and Creme are amongst those whose videos have featured CVI effects.

But according to Fairlight, rock clips are just the beginning of a closer alliance between music and video production. Fairlight's Computer Musical Instrument features SMPTE lock and chase for easier synchronisation to film and videotape when composing or creating sound effects, and the CVI features a "music trigger" which has the effect of controlling colours or shapes by feeding audio into the machine.

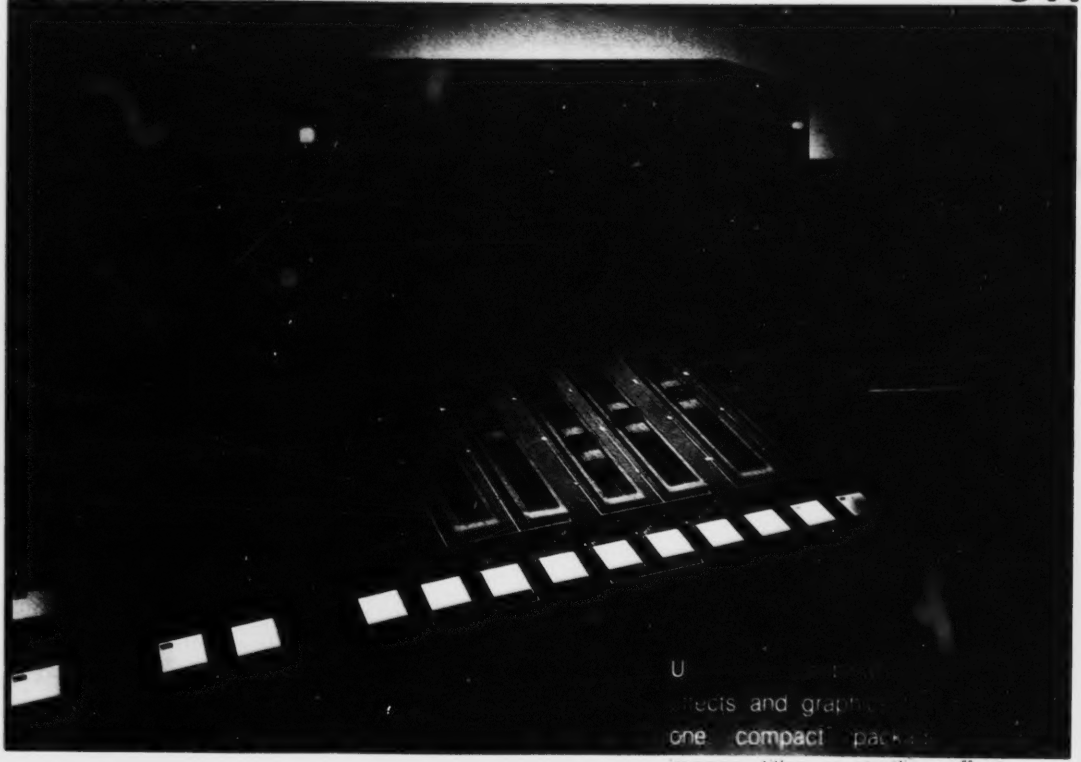
The trend has been more and more that standards are introduced to lock machines in different media together. SMPTE timecode has served this function in synchronising audio to video, and the two creative processes now happen side by side.

Fairlight's unique experience

In future video equipment development, Fairlight looks forward to consolidating its unique position in being able to combine experience in both fields. New technologies enable many creative people to move from one medium to another with relative ease, and the CMI and CVI's approachable software and interactive ergonomic control panels are designed with the creative user in mind.

For more information about Fairlight's video products, contact Fairlight Instruments Pty Ltd, 15 Boundary Street, Rushcutters Bay NSW 2011 Australia. Telephone (02) 331 6333, Telex 127998, Fax (02) 332 3362.

FAIRLIGHT **CVI**



U [illegible] effects and graph[illegible] one compact pac[illegible] images, titles or startling effects – produced quickly, easily and cost-effectively.

Pixelation . . . freeze . . . colourize . . . mirrors . . . inbuilt chromakey . . . user-definable brush shapes and textures . . . cut and paste . . . titling . . . geometric shapes . . . 4096 colours . . . 100 presets . . . save and recall of digital images . . . 2 video inputs . . . sequencer . . . RGB or composite output . . . RS232 communications port.

THE COMPANY BEHIND YOUR SUCCESS

fairlight

Sydney: Fairlight Instruments Pty Ltd (02) 331 6333 **Los Angeles**: Fairlight Instruments Inc. (213) 470 6280 **New York**: Fairlight Instruments Inc. (212) 219 2656 **London**: Syco Video (01) 724 2451 **Bangkok**: MTI (02) 391 0878 **Barcelona**: Datavision 201 5177 **Munich**: Videocation (089) 95 02 08-09 **Milan**: CEM Elettronica (0321) 95151 **Tokyo**: Matsushita Electric Trading Co. (03) 435 4825 **Argentina (Buenos Aires)**: SVC 392 6341 **Argentina (San Miguel de Tucuman)**: Kappa (081) 22 7929 **Sweden (Malmo)**: AB Backaskog Skolservice (044) 53475 **Norway (Stavanger)**: 2MTV 58 29 10

FAIRLIGHT'S COMMITMENT TO SOUND QUALITY

Fairlight Instruments is an Australian company known throughout the world for inventing sound sampling and building the first commercial "Computer Musical Instrument" in 1978. In 1987 Fairlight is continuing expansion of its international sales and support network.

The secret of the company's longevity in the high-tech world where companies notoriously rise and fall with meteoric rapidity has been its commitment to a strong philosophy of quality and specialisation.

The current Computer Musical Instrument (CMI) is a sophisticated computer-based sampling and composition system which produces extremely high quality sound and is extensively used in record, film and television production.

"We regard ourselves as primarily a Research and Development based operation", says Peter Vogel, who, with Kim Ryrie, founded the company in 1975, and who was largely responsible for the design of the first Computer Musical Instrument. One third of the company's employees work in Research and Development, concentrating not only on new products, but also on ongoing software and hardware development of the existing range. "Our philosophy has been to build the best possible product for the job, rather than designing to a budget. Our market is the small group of professionals who can afford to pay for the best."

The **Fairlight CMI Series III**, the company's flagship product, is indeed a deluxe machine for creative sound and music production. Combining multi-channel sampling and synthesis capabilities with powerful SMPTE-based sequencing systems, the Series III is unique in its superb digital quality sound. It can be used in all aspects of sound production, including music composition, sound effects, editing of sound, dialogue and foley, and synchronisation of all of these with film, audio and video.

The Series III can sample over 2.5 minutes of sound at 44.1kHz. Stereo sampling is also a standard feature of the system. An extensive library of traditional musical sounds and not-so-traditional sounds is included with the Series III, and Fairlight is continuing to develop and expand this library according to requests and customers' needs. This has meant organising anything from a recording session with the Sydney Philharmonic Choir to sampling a single grand piano to get the best possible sounds.

A large cross-section of library sounds can be stored at any one time on the system's integrated hard disk. Additional external hard disks mean that a huge library of sound effects, for example, can be kept ready "on-line".

The waveform editing capabilities of the system, as well as a comprehensive "effects" page, allow the user to tailor sounds to specific needs, and to record characteristic playing styles into a sequence by allocating the various controls to parameters such as attack, decay or vibrato.

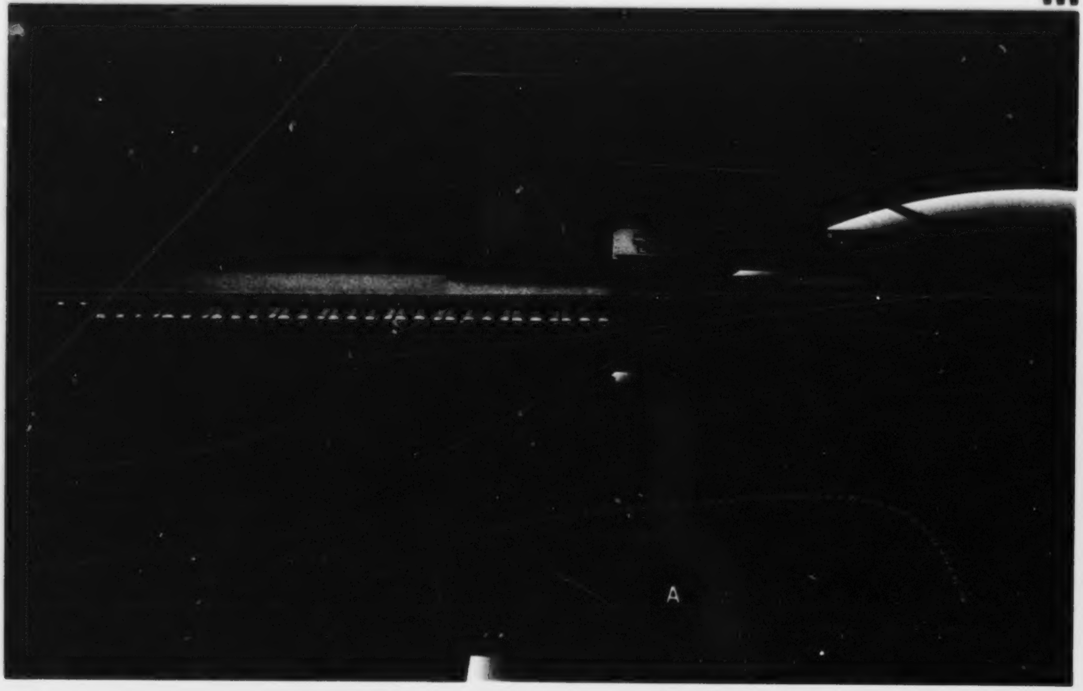
The Series III's sequencing software provides complete control of every aspect of a composition, from playing parts in via the music keyboard to editing and rearranging each phrase of music. Events can be quantised or accurately recorded with 1mS accuracy. SMPTE lock and chase make working with multi-track easy, and are essential in film and video post production.

The CMI Series III has already been used to produce soundtracks for major films, television specials, commercials and documentaries, as well as in record production, all round the world. It is a Fairlight which enables Jan Hammer to meet his weekly deadline for the soundtrack of Miami Vice, one of the world's most popular television series.

Ever since the first Fairlight was built, it has been every musician's dream to own one. Now, more than ever, it is an indispensible tool for fast and flexible sound production of the highest quality.

For more information about the Fairlight Series III, contact Fairlight Instruments Pty Ltd, 15 Boundary Street, Rushcutters Bay, NSW 2011 Australia. Telephone (02) 331 6333, Telex 127998, Fax (02) 332 3362.

SERIES III



The Fairlight Series III is the culmination of years of experience from the people who pioneered "sound sampling" and computer-aided composition and performance.

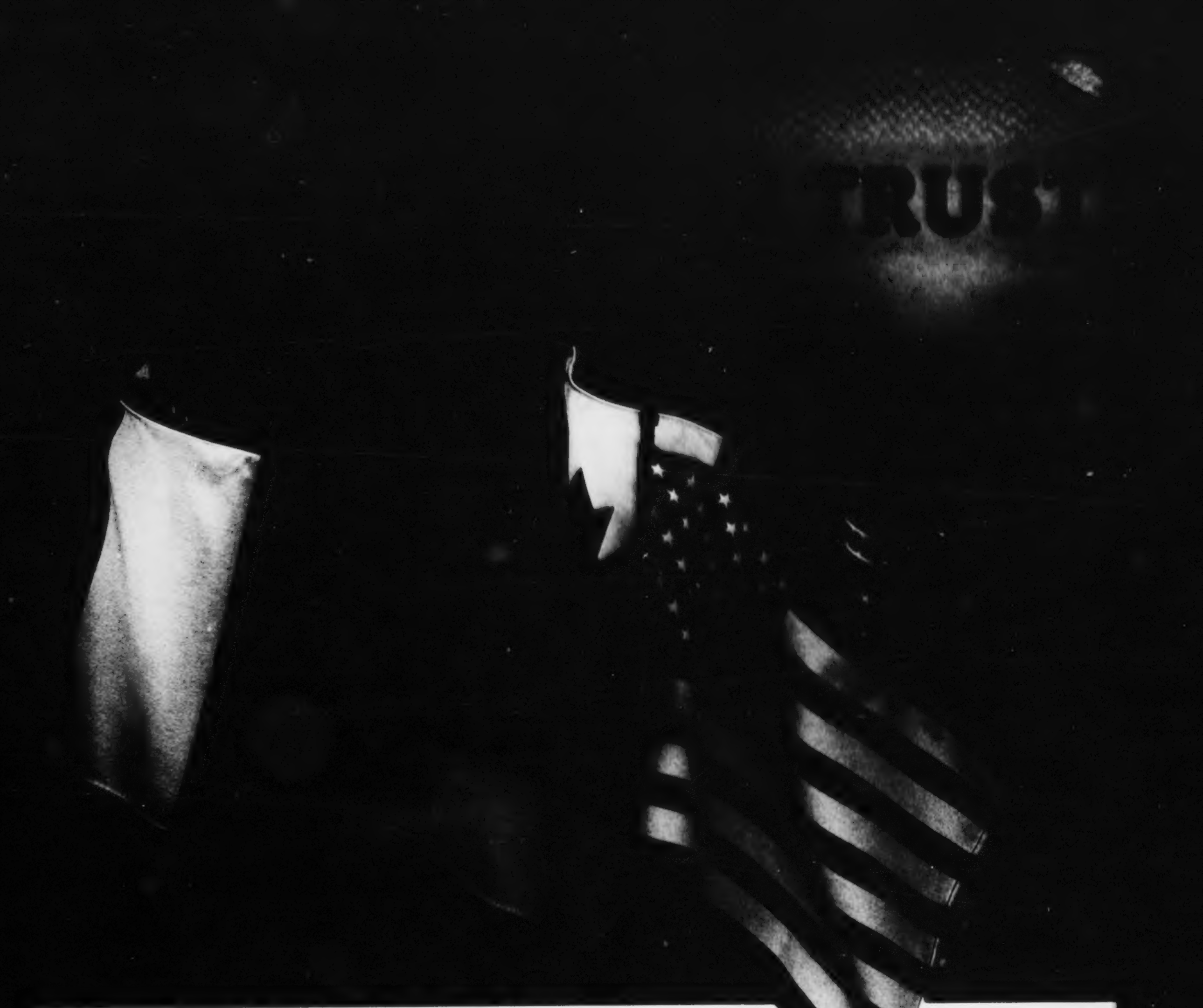
The result is an easy-to-use system of unparalleled power.

Hi-fidelity samples in mono or stereo . . . hard disk for sound storage . . . samples over 2.5 minutes of sound . . . 80-track sequence recording and performance . . . advanced analysis and synthesis . . . specialist film/video scoring software . . . MIDI/SMPTE . . . interactive graphics system.

THE COMPANY BEHIND YOUR SUCCESS

fairlight

Sydney: Fairlight Instruments Pty Ltd (02) 331 6333 **Los Angeles**: Fairlight Instruments Inc (213) 470 6280 **New York**: Fairlight Instruments Inc (212) 219 2656 **Toronto**: Computer Music International (416) 964 1885 **London**: Syco Systems Ltd (01) 724 2451 **Paris**: La Frette Studios (1) 347 4664 **Munich**: Elmulab (089) 812 0574 **Milan**: CEM Elettronica (0321) 95151 **Copenhagen**: SLT (01) 71 3344 **Tokyo**: Matsushita Electric Trading Co (03) 435 4825



Moseley. The Trusted Name in Communications in Over 100 Countries.

The Moseley name has stood for trust and dependability in communications since 1959, when company founder Jack Moseley established his reputation as a pioneer in the design and development of studio-transmitter links for broadcast applications. Mr. Moseley's first priority was to make sure his equipment and installations were the best available, anywhere. But he insisted on more than that.

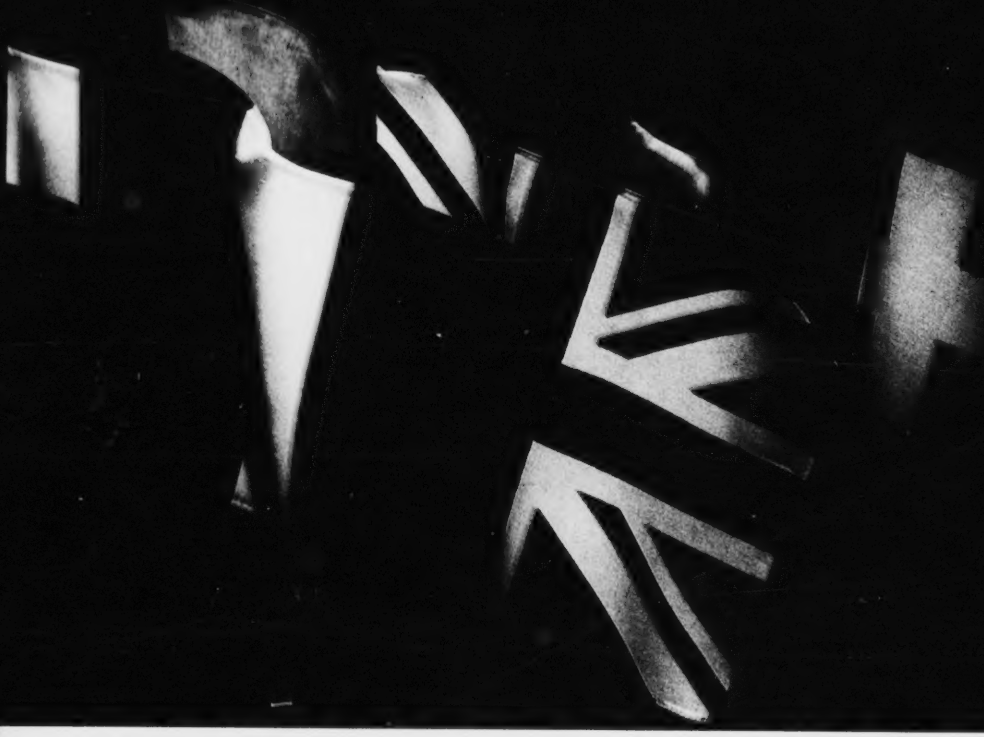
He wanted his customers, large or small, to know that he and his company would always be there to solve any problem, night or day, at any location. And he stuck to that philosophy, year after year.

Today, the Moseley name continues to stand for trust and dependability. Which is why our communications installations are in over 100 countries around the world, from Antigua to Zaire.

But while our philosophy of trust and dependability hasn't changed in 29 years of business, our capabilities have. And in an impressive way.

We now serve our customers' total control and communications needs,

Copyright © 1987, Moseley.



from small but important rural communications projects to multi-million dollar systems. Systems that propel our customers into the vanguard of 21st century world telecommunications. Systems backed by our philosophy of total support, from assessing communications needs to long-term service contracts after installation.

Just as important, our systems are based on relevant, proven technology that is both cost-effective and custom-designed to your needs. And we may be able to offer financial services to provide you with new sources of funding.

Give us a call if you are considering a communications project and you would like to discuss it with a Moseley engineer. Our worldwide representatives are listed on the following page.

You will soon discover why Moseley is the trusted name in communications in over 100 countries around the world.

Moseley

The Trusted Name in Communications™

▼

Moseley
Associates
Incorporated

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Santa Barbara, CA
93117-3093

a
Flow General
Company

Phone 805 968 9621
Telex 658448
Cable: MOSELEY

International Representatives and Distributors

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Buenos Aires, Argentina
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795-1922
TLX: (390) 26144 TRAME AR

ARUBA

Arturo Arends
P.O. Box 19
Newton Street #12
Aruba, Netherlands Antilles
Tele: (297-8) 21339

AUSTRALIA

Quinto Communications
63 Kingsway
South Melbourne
Victoria 3205, Australia
Tele: (61-3) 61-3541
TLX: (790) 34732 KLARI AA
FAX: (61-3) 62-3362

Spares and Svc. only
Tele: (61-2) 452-5522
TLX: (790) 121083 LSETEC AA
FAX: (61-2) 452-2308

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Eletro Equip
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TLX: (391) 1132355 EEEE BR

Savana Comunicacoes Ltda.
Rua Visconde do Piraja, 547
Ipanema, Rio de Janeiro
RJ, Brazil
Tele: (55-21) 274-5009
TLX: (391) 2121007 SVCL

CHILE

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TLX: (392) 340412 PBVTR CK

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TLX: (396) 45574 CABCO CO

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TLX: (854) 13800 ERCO S

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Tele: (30-1) 7755642
TLX: (863) 219185 TELM GR

HAITI

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2. Reliability
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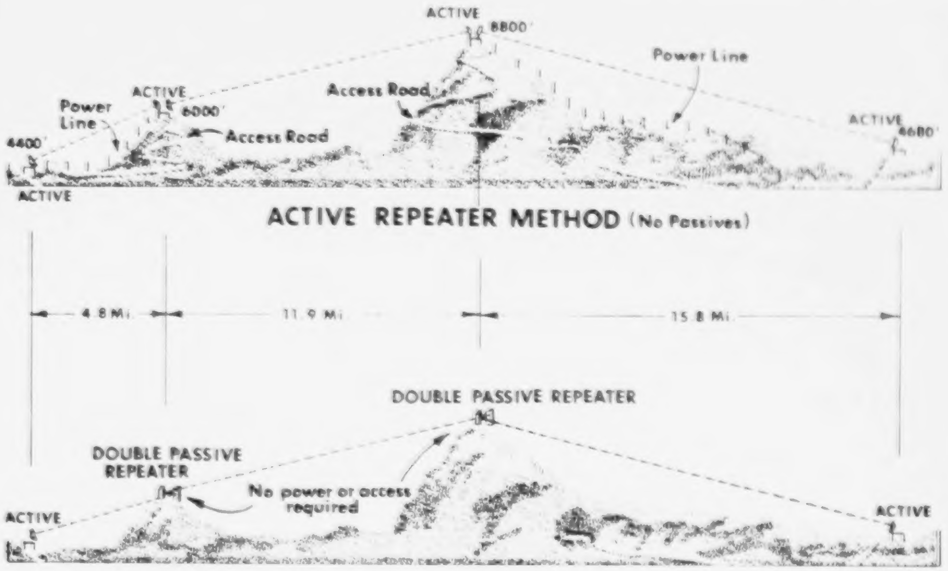
ACTIVE
8800'
Power Line
ACTIVE
Power Line
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Access Road
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ACTIVE
ACTIVE REPEATER METHOD (No Passives)
4.8 Mi.
11.9 Mi.
15.8 Mi.
DOUBLE PASSIVE REPEATER
DOUBLE PASSIVE REPEATER
No power or access required
ACTIVE
ACTIVE

PASSIVE REPEATER METHOD

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SOLID GROWTH IN MICROWAVE INDUSTRY

CONTINENTAL Microwave was established fourteen years ago and has a continuous record of growth. It is now respected world-wide as a supplier of electronic equipment for the telecommunications, broadcast and defence markets.

That strong position starts from the Company's basic commitment and expertise in the technology of frequency control and signal generation. There has always been an understanding that to meet the changing and challenging demands of customers, a vigorous investment programme was vital. Investment in production, research and development, and people – in short, investment in the future. They have over the last fourteen years taken a planned route of strategic vertical integration, this gives it the technological means and muscle to respond from single function assemblies requirements right through to complete systems.

Continental Microwave begins with a unique capability in the generation of radio frequency signals from VHF to microwave with the addition of signal processing. Its single function assemblies include microwave oscillators and synthesizers for use in satellite communication earth terminals. Amplifiers using silicon and gallium arsenide semi-conductors, modulators and demodulators, are among company designed and manufactured components.

The combination of single function assemblies results in multifunction assemblies. The company has an established reputation in this market, supplying amongst others, frequency conversion sub-systems for use in military shipboard satellite communications terminals and microwave receivers.

Microwave transmitters, television transmitters, television transposers – these are part of the complete equipment products. They represent the third stage in the company's highly sophisticated and vertically integrated approach. But the very highest level is in its production of complete systems.

The stress put on vertical integration is a dual strength. A strength for the company in its corporate structure, but equally a strength for the customer in knowing that their requirements can be tackled at whatever level they enter negotiations. This approach has given the company a technology leadership, a responsive supporting structure and market awareness in design, production and service.

Within the company's broadcasting activities it has long experience in the manufacture of a range of television transmitters and transposers. It is a major supplier in the UK to both the British Broadcasting Corporation and the Independent Broadcasting Authority. Other recent contracts include SSVC in West Germany.

The company has total capability in the low power TV supply and installation market up to 1KW. The range includes transmitters for direct broadcast from studios, VTR or satellite sources, as well as transposers for fill-in and relay purposes. Both the TC33-20 and TT40-20 low level transposers are established products, incorporating fully programmable frequency synthesis, high quality SAW filter, built-in monitoring by LED and switchable meter. Test equipment covering the field and base servicing requirements for the transmitters and transposers complete this package.

The Telecommunications Division is heavily engaged in manufacturing phase-lock signal sources, VHF/Microwave synthesizers and frequency converters – all of which are key elements in Satellite Earth Stations. The 'P' series Phase-Locked Signal Sources are designed specifically for microwave applications that require exceptional operating stability and spectral purity. Another leading product in this area is the Satellite Beacon Receiver, featuring 70 MHZ phase-lock receiver, coherent AM demodulator indicating received signal strength, and automatic search and lock capability in the range 70 MHZ ± 100 KHZ.

Continental Microwave had adopted advanced satellite earth station technology to the needs of the outside broadcast engineer and advanced microwave communications link concepts in terms of rapid deployment and operational frequency flexibility. These portable links include the VML-D all solid state link series. Although primarily intended for outside broadcast television transmission, all VML-D systems are rated for 24 operation in very average environments and are therefore eminently suitable for semi-permanent use in studio-to-transmitter and emergency telephone restoration rolls up to 1800 FDM channels. Compatible ENG, air-to-ground and portable links, VML-D series are in the 1.4 to 2.7 GHZ frequency band.

Continental Microwave has gained a good deal of respect over the years, working for internationally renowned companies and government agencies. The company has played a leading role through design innovation, production know-how and a strong engineering capability. These are the qualities that will also ensure combined product excellence in the future. □

COMMUNICATION FOR THE WORLD

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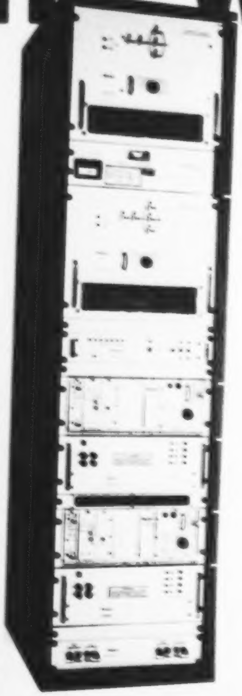

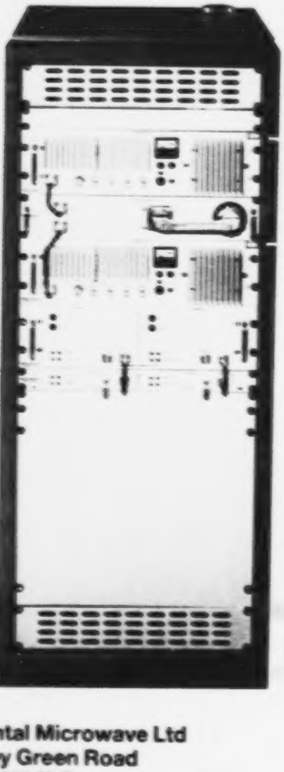

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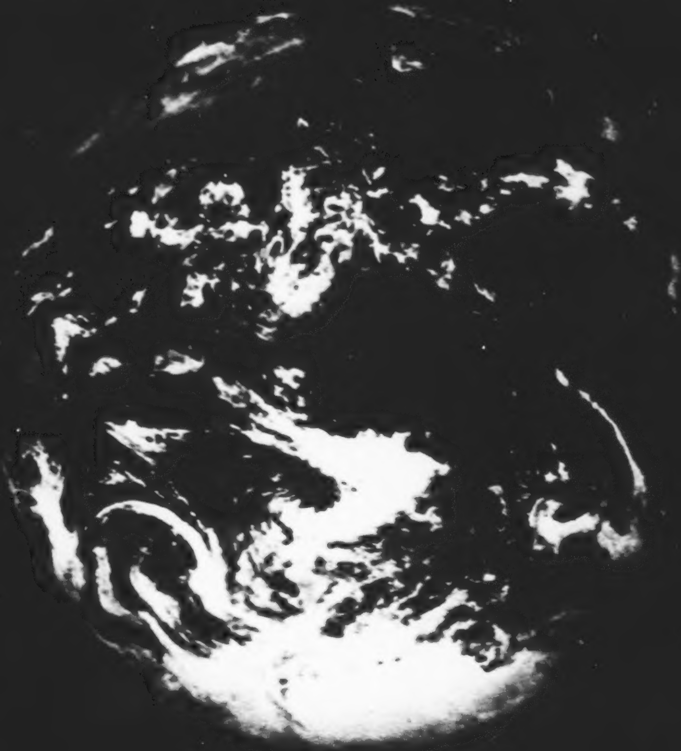

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Reliance Comm/Tec. Group Headquarters. 8600 W Bryn Mawr. North Tower. Suite 950. Chicago. IL 60631. USA. Tel: 312 693 0400. Fax: 312 693 7618. Telex: 270374.

Rohn. PO Box 2000. Peoria. Illinois. USA. Tel: 309 697 4400. Telex: 910 652 0646. Fax: 309 697 5612.

Sagem. Telex and Office Automation Division. 6 Avenue d'Lena. 75783. Paris Cedex. France. Tel: + 33 1 47 23 5455. Telex: 614528. Fax: 933 142912370.

Satellite Consultants International Inc. PO Box 1509. Idaho Springs. CO 80452. USA. Tel: 303 567 4679. Telex: 362559.

Schrack Elecktronik AG. Pottendorferstrasse 25 27. 1120 Vienna. Austria. Tel: 43 222 8501. Telex: 131591.

Scientific-Atlanta. PO Box 105027. Atlanta. GA 30348. USA. Tel: 404 449 2684. Telex: 4611804.

Scientific Radio Systems Incorporated. 367 Orchard Street. Rochester. NY 14606. USA. Tel: 716 235 2040.

Sennheiser Electronik. D-3002 Wedemark. West Germany. Tel: 49 5130 5830.

Siemens AG Osterreich. A-1031 Vienna. Austria. PO Box 326. Tel: + 43 222 72 93-0. Telex: 1372-41. Fax: 3222450.

Standard Elektrik Lorenz AG. International Business Telecommunications. PO Box 40 07 49. D-7000 Stuttgart 40. West Germany. Tel: (+49 71 41) 124 356. Telex: 7 2 526 215.

Stanton Magnetics Incorporated. Department FC. 200 Terminal Drive. Planview. NY 11803. USA. Tel: 718-445 0063.

Sony Broadcast Limited.
Belgrave House. Basing View. Basingstoke. Hants. UK. Tel: 0256 55011.

Sperry Incorporated. Highway 17. PO Box 1300. Rockland. Ontario. KOA 3AQ. Canada. Tel: 613 446 6011.

Swedish Telecoms International AB. PO Box 3538. S-10369 Stockholm. Sweden. Tel: +46 8 781 05 20. Telex: 11707. Telefax: + 46 810 88 55.

Tekelec Instruments. 6 Rue Louis Pasteur. 92100 Boulogne. France. Tel: 33 1 46 04 81 42. Telex: 205443. Fax: 33 1 46 04 19 51.

Telefonaktiebolaget LM Ericsson. Corporate Relations. S-126 25 Stockholm. Sweden. Tel: 46 8 719 00 00.

Telespazio. Via Alberto. Bergamini No 50. Rome 00159. Italy. Tel: 396 49871. Telex: 610654.

Telettra Espanola SA. CA Raimundo Fernandez Villaverde. 65-28003 Madrid. Spain. Tel: 456 30 93. Telex: 22485. Fax: 4562415.

Teltone Corporation. 10801 120th Avenue NE Kirkland. Washington 98033. USA. Tel: 206 827 9626. Fax: 206 827 6050. Telex: 910 449 2862.

Texar Incorporated. 616 Beatty Road. Monroeville. PA 15146 1502. USA. Tel: 412 856 4276. Telex: 910 240 9185. Fax: 412 856 4656.

James Thomas Engineering Limited. Station Approach. Pershore Trading Estate. Pinvin. Nr Pershore. Worcs WR10 2DB. UK. Tel: 0386 553002.

Tiffen Manufacturing Corporation. 90 Oser Avenue. Hauppauge. New York 11788. Tel: 516 273 2500. Telex: 22 1640.

T I W Systems International. 1284 Geneva Drive. Sunny Vale. California 94089 USA. Tel: 408 734 3950.

UNI-LAB Telecommunications Limited. 459 Scarborough Beach Road. Osborn Park. Western Australia 6017. Australia. Tel: 619 444 9855.

Vanderhoff plc. Bermuda Road. Nuneaton. Warwickshire. UK. Tel: 0203 431111.

Voicecall Communications Pty Limited. Level 4. Voicecall House. 17 Randall Street. Surrey Hills. NSW 2010. Australia. Tel: 612 211 3688.

Wang Laboratories Incorporated. European HQ. Wang House. 1000 Great West Road. Brentford. Middlesex TW8 9HL. UK. Tel: 01 568 9200. Telex: 568 5199.

Western Multiplex Corporation. 1320 Bayport Ave. San Carlos. California 94070. USA. Tel: 415 592 8832. Telex: 295114.

		AC-DC CONVERTERS	ANTENNAS	ANTENNAS (SATELLITE)	AUDIO RECORDING	BATTERIES	BROADCAST CONSOLES	BROADCAST TRANSMITTERS	CABLES - ACCESSORIES	CABLES - CABLE LASHERS	CABLES - COAXIAL	CABLES – FIBRE OPTIC	CABLES - FIBRE OPTIC COMPONENTS	CABLES - LAYING	CABLES - SUBMARINE	CABLES - TWISTED	CALL MANAGEMENT & LOGGING SYSTEMS	CELLULAR RADIO	CHARGERS	CIRCUIT BOARDS
1	AEL Communications Ltd																			
2	Alcatel Austria Aktiengesellschaft																			
3	Altec Lansing																			
4	Applicazioni Elettrotelefoniche AET S.p.A												●	●		●				
5	ATS Communications Ltd																			
6	Auditronics Inc						●													
7	Australian Trade Commission																			
8	Austria Telecommunication GmbH																			
9	Aydin Corporation (West)																			
10	BAL Components Ltd																			
11	Barco Industries N.V.																			
12	Beckman Industrial Ltd																			
13	Bell Canada International Inc																			
14	Bell South Corporation											●								
15	British Telecom Overseas Division																			
16	Browning Labs Inc							●			●									
17	Calzarara S.p.A		●																	
18	Canon																			
19	Catace Pty Ltd																●			
20	Centre Corporation																●	●		
21	Christian Rovsing A/S Af 1984																			
22	Cinerent AG																			
23	Circuit Research Laboratories Inc																			
24	Coherent Communications Systems Corp															●				
25	Continental Electronics						●													
26	Continental Microwave																			
27	Ceiro		●	●																
28	Datapro																			
29	Datap Systems																			
30	Alan Dick & Co Ltd		●						●		●									

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
COAXIAL FILTERS (ANTENNA SYSTEMS)																														●
COMBINERS (ANTENNA SYSTEMS)																														●
CONNECTORS - COAXIAL																●														●
CONNECTORS - ELECTRICAL/MULTIPIN/CYLINDRICAL																														
CONNECTORS - FIBRE OPTIC																														
CONSULTANCY & PLANNING								●					●		●					●										
DATACOM AIDS				●																				●						
DATACOMMUNICATIONS TEST EQUIPMENT																														
DATA INFORMATION SYSTEMS COMPONENTS																								●						
DATA INFORMATION SYSTEMS POWER EQUIPMENT																														
DATA INFORMATION SYSTEMS SOFTWARE																											●			
DATA INFORMATION SYSTEMS TEST EQUIPMENT																								●						
DIGITAL DROP/INSERT EQUIPMENT																														
DIGITAL RADIO RELAY SYSTEMS																														
DIGITAL TRANSMISSION SYSTEMS																														
DIRECTORY ASSISTANCE SYSTEMS																			●											
EAR MIKES																														
ELECTROMAGNETIC & LIGHTING PROTECTION																														
ELECTRONIC MAIL																														
ELECTRONIC SURVEILLANCE																														
EMERGENCY TELEPHONE SYSTEMS																														
ENCRYPTION																					●									
EXHIBITIONS																														
FACSIMILE																		●												
FEATUREPHONES/HANDSETS															●															
FIXED INSTALLATION SOUND SYSTEMS			●																											
HEADSETS																														
INFORMATION SYSTEMS																				●										
INTEGRATED INFORMATION SYSTEMS																		●	●	●										
INTERCOMS			●																											
INTERFACE CONVERTERS																								●						
ISDN (LAN-EWSD ETC.)								●							●					●										
JOURNALS																												●		
KEYPHONES																														
LEAD ACID/CADMIUM NICKEL BATTERIES																														
LINE PLANT EQUIPMENT																														

		AC-DC CONVERTERS	ANTENNAS	ANTENNAS (SATELLITE)	AUDIO RECORDING	BATTERIES	BROADCAST CONSOLES	BROADCAST TRANSMITTERS	CABLES - ACCESSORIES	CABLES - CABLE LASHERS	CABLES - COAXIAL	CABLES- FIBRE OPTIC	CABLES - FIBRE OPTIC COMPONENTS	CABLES - LAYING	CABLES - SUBMARINE	CABLES - TWISTED	CALL MANAGEMENT & LOGGING SYSTEMS	CELLULAR RADIO	CHARGERS	CIRCUIT BOARDS
31	Dornier Systems GmbH																			
32	Dynaudio APS																			
33	ECI Telecom																			
34	ECO Ltd																			
35	Electro-Voice																			
36	Elektronorgtechnika																			
37	Elit Electronica Italiana S.p.A							●												
38	Emcee Broadcast Products							●												
39	Enertec Instruments																			
40	Face Finanziaria																			
41	Fairlight Instruments																			
42	Fortel Incorporated																			
43	GN Elmi A/S																●			
44	GN Netcom A/S																			
45	Hallikainen & Friends Inc																			
46	Harris Corporation-Farinon Division																			
47	Heyden-Spike Ltd																			
48	Howe Audio Productions																			
49	Hubcom/Hubbard Communications Inc			●																
50	Intelligent Business Coms CP																			
51	Intelsat																			
52	Iskra																			
53	Jupiter Technology Inc																			
54	Kapsch Aktiengesellschaft																			●
55	Kevo Foreign Trade Corp																			
56	Lea Dynatech Incorporated																			
57	Leblanc & Royle Telcom Inc		●					●												
58	LK Products																			
59	Loral Terracom																			
60	M/A-Com Telecommunications Division																			

	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
COAXIAL FILTERS (ANTENNA SYSTEMS)																														
COMBINERS (ANTENNA SYSTEMS)																														
CONNECTORS – COAXIAL																														
CONNECTORS – ELECTRICAL/MULTIPIN/CYLINDRICAL																														
CONNECTORS – FIBRE OPTIC																														
CONSULTANCY & PLANNING																														
DATACOM AIDS														●									●							
DATACOMMUNICATIONS TEST EQUIPMENT									●																					
DATA INFORMATION SYSTEMS COMPONENTS										●				●																
DATA INFORMATION SYSTEMS POWER EQUIPMENT																														
DATA INFORMATION SYSTEMS SOFTWARE																								●						
DATA INFORMATION SYSTEMS TEST EQUIPMENT																														
DIGITAL DROP/INSERT EQUIPMENT																														
DIGITAL RADIO RELAY SYSTEMS																														
DIGITAL TRANSMISSION SYSTEMS																														
DIRECTORY ASSISTANCE SYSTEMS																														
EAR MIKES																	●													
ELECTROMAGNETIC & LIGHTING PROTECTION																										●				
ELECTRONIC MAIL										●																				
ELECTRONIC SURVEILLANCE																														
EMERGENCY TELEPHONE SYSTEMS																			●					●						
ENCRYPTION																														●
EXHIBITIONS																														
FACSIMILE										●																				
FEATUREPHONES/HANDSETS																								●	●					
FIXED INSTALLATION SOUND SYSTEMS																														
HEADSETS														●			●													
INFORMATION SYSTEMS																							●	●						
INTEGRATED INFORMATION SYSTEMS																							●	●						
INTERCOMS																	●								●					
INTERFACE CONVERTERS																								●						
ISDN (LAN-EWSD ETC.)										●			●											●	●					
JOURNALS																														
KEYPHONES																								●						
LEAD ACID/CADMIUM NICKEL BATTERIES																														
LINE PLANT EQUIPMENT																														

		AC-DC CONVERTERS	ANTENNAS	ANTENNAS (SATELLITE)	AUDIO RECORDING	BATTERIES	BROADCAST CONSOLES	BROADCAST TRANSMITTERS	CABLES – ACCESSORIES	CABLES – CABLE LASHERS	CABLES – COAXIAL	CABLES– FIBRE OPTIC	CABLES – FIBRE OPTIC COMPONENTS	CABLES – LAYING	CABLES – SUBMARINE	CABLES – TWISTED	CALL MANAGEMENT & LOGGING SYSTEMS	CELLULAR RADIO	CHARGERS	CIRCUIT BOARDS
61	McDonnell Douglas Information Systems Int			●																
62	Mannesmann Tally GmbH																			
63	Mashpriborintorg		●	●	●			●										●		
64	Maxon Electronics Middle East Ltd																			
65	MCL Ltd																			
66	Memotec Data Inc																			
67	Microflect Co Inc																			
68	Mitec Electronics Ltd																			
69	Morgan Laboratories Ltd																			
70	Moseley Associates Inc							●												
71	Motronic																			
72	Multi Point Communications																			
73	Multi-Tech Systems International																			
74	Multitone Communications Systems Ltd																			
75	Mutltone Electronics																			
76	Mycomp Technologies Corp																			
77	Netcom (Australia) Pty Ltd																			
78	Nixdorf Computer AG																			
79	Nokia-Mobira OY																	●		
80	Nokia Telecommunications																			
81	Nytone Inc																			
82	OTC Australia																			
83	Philips Elektronikindustrier AB																			
84	Phillips Kommunikations Industrie AG											●								
85	Photodyne Inc																			
86	Photowatt International SA					●													●	
87	RC Computer A/S																			
88	Reliance Comm/Tec	●																	●	
89	Sagem																			
90	Satellite Consultants International Inc																			

	90	89	88	87	86	85	84	83	82	81	80	79	78	77	76	75	74	73	72	71	70	69	68	67	66	65	64	63	62	61
COAXIAL FILTERS (ANTENNA SYSTEMS)																							●							
COMBINERS (ANTENNA SYSTEMS)																							●							
CONNECTORS – COAXIAL			●																											
CONNECTORS – ELECTRICAL/MULTIPIN/CYLINDRICAL																														
CONNECTORS – FIBRE OPTIC																														
CONSULTANCY & PLANNING	●																						●							●
DATACOM AIDS				●																										
DATACOMMUNICATIONS TEST EQUIPMENT																												●		
DATA INFORMATION SYSTEMS COMPONENTS				●																										
DATA INFORMATION SYSTEMS POWER EQUIPMENT																														
DATA INFORMATION SYSTEMS SOFTWARE																														
DATA INFORMATION SYSTEMS TEST EQUIPMENT																														
DIGITAL DROP/INSERT EQUIPMENT											●																			
DIGITAL RADIO RELAY SYSTEMS											●																			
DIGITAL TRANSMISSION SYSTEMS											●																			
DIRECTORY ASSISTANCE SYSTEMS				●																										
EAR MIKES																														
ELECTROMAGNETIC & LIGHTING PROTECTION			●																											
ELECTRONIC MAIL		●																									●			●
ELECTRONIC SURVEILLANCE																														
EMERGENCY TELEPHONE SYSTEMS																				●								●		
ENCRYPTION		●																												
EXHIBITIONS																														
FACSIMILE																												●		
FEATUREPHONES/HANDSETS																														
FIXED INSTALLATION SOUND SYSTEMS																														
HEADSETS																														
INFORMATION SYSTEMS		●		●																										
INTEGRATED INFORMATION SYSTEMS				●						●																				●
INTERCOMS																	●													
INTERFACE CONVERTERS																														
ISDN (LAN-EWSD ETC.)											●		●																	
JOURNALS									●																					
KEYPHONES																														
LEAD ACID/CADMIUM NICKEL BATTERIES																														
LINE PLANT EQUIPMENT																														

		AC-DC CONVERTERS	ANTENNAS	ANTENNAS (SATELLITE)	AUDIO RECORDING	BATTERIES	BROADCAST CONSOLES	BROADCAST TRANSMITTERS	CABLES – ACCESSORIES	CABLES – CABLE LASHERS	CABLES – COAXIAL	CABLES– FIBRE OPTIC	CABLES – FIBRE OPTIC COMPONENTS	CABLES – LAYING	CABLES – SUBMARINE	CABLES – TWISTED	CALL MANAGEMENT & LOGGING SYSTEMS	CELLULAR RADIO	CHARGERS	CIRCUIT BOARDS
91	**Schrack Elektronik AG**																			
92	**Scientific-Atlanta Inc**			●				●			●									
93	**Scientific Radio Systems Inc**																			
94	**Sennheiser Electronic KG**																			
95	**Siemens AG Österreich**								●		●	●		●						
96	**Sony Broadcast Ltd**				●															
97	**Sperry Aerospace Division (Honeywell) Ltd**																			
98	**Standard Electrica SA**										●	●		●				●		
99	**Standard Electrik Lorenz AG**																			
100	**Stanton Magnetics Inc**																			
101	**Storno A/S**	●																●	●	●
102	**Swedish Telecoms International AB**																	●		
103	**Tekelec Instruments**																			
104	**Telecom Australia (International) Ltd**																			
105	**Telefonaktiebolaget LM Ericsson**			●		●					●	●	●		●	●		●	●	●
106	**Telespazio S.p.A**																			
107	**Telettra Española SA**										●	●							●	
108	**Teltone Corporation**																●			
109	**Texar Incorporated**				●			●												
110	**James Thomas Engineering**																			
111	**Tiffen Manufacturing Corp**																			
112	**TIW Systems Incorporated**		●	●																
113	**TSI (Telecommunications Services International)**																			
114	**Uni-Lab Telecommunications Ltd**																	●		
115	**UNR Rohn Inc**																	●		
116	**Vanderhoff Business Systems Ltd**				●												●	●		
117	**Vanderhoff Communications Ltd**	●																	●	●
118	**Voicecall Communications Pty**																			
119	**Wang Laboratories Inc**																			
120	**Western Multiplex Corp**																			

120	119	118	117	116	115	114	113	112	111	110	109	108	107	106	105	104	103	102	101	100	99	98	97	96	95	94	93	92	91	
																														COAXIAL FILTERS (ANTENNA SYSTEMS)
																														COMBINERS (ANTENNA SYSTEMS)
																														CONNECTORS – COAXIAL
																														CONNECTORS – ELECTRICAL/MULTIPIN/CYLINDRICAL
																														CONNECTORS – FIBRE OPTIC
			●			●	●						●		●	●		●							●			●		CONSULTANCY & PLANNING
																														DATACOM AIDS
																	●						●					●		DATACOMMUNICATIONS TEST EQUIPMENT
															●								●							DATA INFORMATION SYSTEMS COMPONENTS
			●												●															DATA INFORMATION SYSTEMS POWER EQUIPMENT
															●										●					DATA INFORMATION SYSTEMS SOFTWARE
			●												●		●													DATA INFORMATION SYSTEMS TEST EQUIPMENT
																														DIGITAL DROP/INSERT EQUIPMENT
																														DIGITAL RADIO RELAY SYSTEMS
																														DIGITAL TRANSMISSION SYSTEMS
				●														●												DIRECTORY ASSISTANCE SYSTEMS
																														EAR MIKES
			●																											ELECTROMAGNETIC & LIGHTING PROTECTION
	●														●			●							●					ELECTRONIC MAIL
																														ELECTRONIC SURVEILLANCE
			●	●																					●					EMERGENCY TELEPHONE SYSTEMS
																												●		ENCRYPTION
																														EXHIBITIONS
																						●			●					FACSIMILE
				●											●															FEATUREPHONES/HANDSETS
																														FIXED INSTALLATION SOUND SYSTEMS
				●																						●				HEADSETS
																		●				●	●							INFORMATION SYSTEMS
															●							●			●					INTEGRATED INFORMATION SYSTEMS
				●											●							●								INTERCOMS
																														INTERFACE CONVERTERS
			●										●		●			●			●	●	●		●					ISDN (LAN-EWSD ETC.)
																														JOURNALS
				●																		●								KEYPHONES
															●															LEAD ACID/CADMIUM NICKEL BATTERIES
																														LINE PLANT EQUIPMENT

		MESSAGE SWITCHING	MICROCOMPUTERS	MICROPHONES	MICROPROCESSOR REMOTE CONTROL SYSTEMS	MICROWAVE INSTALLATION SERVICES	MICROWAVE TRANSMISSION	MOBILE RADIO	MOBILE TELEPHONE EXCHANGES	MONITORING LOUDSPEAKERS	MULTIPLEXERS/MODEMS	NETWORK MANAGEMENT SYSTEMS	OPTICAL FILTERS	OPTICAL TRANSMISSION SYSTEMS FOR VIDEO AUDIO	OPTO-ELECTRONIC	PACKET SWITCHING	PAGING SYSTEMS	PASSIVE COMPONENTS (LAND MOBILE ANTENNAE)	PAY/CREDIT CARD TELEPHONES	PHOTOCOPIERS
1	AEL Communications Ltd							●												
2	Alcatel Austria Aktiengesellschaft																			
3	Altec Lansing																●			
4	Applicazioni Elettrotelefoniche AET S.p.A										●					●				
5	ATS Communications Ltd	●																		
6	Auditronics Inc																			
7	Australian Trade Commission																			
8	Austria Telecommunication GmbH																			
9	Aydin Corporation (West)					●	●													
10	BAL Components Ltd																			
11	Barco Industries N.V.																			
12	Beckman Industrial Ltd																			
13	Bell Canada International Inc																			
14	Bell South Corporation																			
15	British Telecom Overseas Division											●								
16	Browning Labs Inc			●			●													
17	Calzarara S.p.A					●	●	●												
18	Canon																			●
19	Catsco Pty Ltd											●								
20	Centre Corporation					●	●	●						●						
21	Christian Rovsing A/S Af 1984	●																		
22	Cinerent AG																			
23	Circuit Research Laboratories Inc																			
24	Coherent Communications Systems Corp										●									
25	Continental Electronics																			
26	Continental Microwave					●	●													
27	Csiro		●																	
28	Datapro																			
29	Datap Systems											●								
30	Alan Dick & Co Ltd					●														

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
POWER SUPPLIES										●						●														
PRINTERS & NETWORK SYSTEMS																														
PROGRAMMABLE PAY TELEPHONE CONTROLLERS																														
PROTOCOL TESTERS																														
PUBLIC EXCHANGES								●																						
RADIAL & PARTY LINE DESPATCHER SYSTEMS																														
RADIO PAGING SYSTEMS																														
RECEIVING & TRANSMISSION (RADIO)	●																			●										
RECORDING & BROADCASTING ACCESSORIES										●						●														
RECORDING & BROADCASTING EQUIPMENT						●			●	●	●					●						●	●		●					
RECORDING & BROADCASTING SERVICES																							●							
RECTIFIERS																														
SATELLITE COMMUNICATIONS SYSTEMS																				●							●			
SATELLITE EARTH STATIONS											●									●						●	●			
SILICON SURGE SUPPRESSION COMPONENTS																														
SINGLE CHANNEL PER CARRIER EQUIPMENT																				●										
SMALL/MEDIUM/HIGH CAPACITY LINE TRANSMISSION																														
SOUND REINFORCEMENT PRODUCTS																														
SPECIAL TELEPHONE OPERATIONS & MAINTENANCE																														
SSPG PABX/PABX – PRIVATE		●													●															
STATIC FREQUENCY CONVERTERS																														
STATIC INVERTERS																														
STUDIO-TO-TRANSMITTER MICROWAVE LINK SYSTEMS																														
SUPERVISION MANAGEMENT & REMOTE CONTROL				●															●										●	
SWITCHING SYSTEMS																														
TELECOMMUNICATIONS TEST EQUIPMENT																														
TELECOM. TESTING – DIGITAL/PCM																														
TELECOM. TESTING – FIBRE OPTIC																														
TELECOM. TESTING – TRANSMISSION & NOISE																														
TELECOM. TESTING – VOICE NETWORK MANAGEMENT				●															●											
TELE CONFERENCING SYSTEMS (VIDEO)			●	●							●									●										
TELEMETRY SYSTEMS					●																									
TELEPHONE ANSWERING SYSTEMS																														
TELEPRINTERS																														
TELEX & DATA TERMINALS					●																									
TERMINALS/DISPLAYS					●																									

No.	Company	MESSAGE SWITCHING	MICROCOMPUTERS	MICROPHONES	MICROPROCESSOR REMOTE CONTROL SYSTEMS	MICROWAVE INSTALLATION SERVICES	MICROWAVE TRANSMISSION	MOBILE RADIO	MOBILE TELEPHONE EXCHANGES	MONITORING LOUDSPEAKERS	MULTIPLEXERS/MODEMS	NETWORK MANAGEMENT SYSTEMS	OPTICAL FILTERS	OPTICAL TRANSMISSION SYSTEMS FOR VIDEO AUDIO	OPTO-ELECTRONIC	PACKET SWITCHING	PAGING SYSTEMS	PASSIVE COMPONENTS (LAND MOBILE ANTENNAE)	PAY/CREDIT CARD TELEPHONES	PHOTOCOPIERS
31	**Dornier Systems GmbH**																			
32	**Dynaudio APS**									●										
33	**ECI Telecom**																			
34	**ECO Ltd**																			
35	**Electro-Voice**			●																
36	**Elektronorgtechnika**																			
37	**Elit Electronica Italiana S.p.A**																			
38	**Emcee Broadcast Products**						●													
39	**Enertec Instruments**																			
40	**Face Finanziaria**																			
41	**Fairlight Instruments**																			
42	**Fortel Incorporated**																			
43	**GN Elmi A/S**																			
44	**GN Netcom A/S**																			
45	**Hallikainen & Friends Inc**																			
46	**Harris Corporation-Farinon Division**					●	●													
47	**Heyden-Spike Ltd**																			
48	**Howe Audio Productions**																			
49	**Hubcom/Hubbard Communications Inc**																			
50	**Intelligent Business Coms CP**																			
51	**Intelsat**																			
52	**Iskra**		●												●					
53	**Jupiter Technology Inc**	●	●									●				●				
54	**Kapsch Aktiengesellschaft**		●			●		●	●		●					●			●	
55	**Kovo Foreign Trade Corp**										●									
56	**Lea Dynatech Incorporated**																			
57	**Leblanc & Royle Telcom Inc**						●													
58	**LK Products**																			
59	**Loral Terracom**						●	●			●									
60	**M/A-Com Telecommunications Division**											●				●				

	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	45	44	43	42	41	40	39	38	37	36	35	34	33	32	31
POWER SUPPLIES																														
PRINTERS & NETWORK SYSTEMS																					●							●		
PROGRAMMABLE PAY TELEPHONE CONTROLLERS																														
PROTOCOL TESTERS																		●												
PUBLIC EXCHANGES							●											●												
RADIAL & PARTY LINE DESPATCHER SYSTEMS																														
RADIO PAGING SYSTEMS																														
RECEIVING & TRANSMISSION (RADIO)		●				●	●																	●						
RECORDING & BROADCASTING ACCESSORIES						●																								
RECORDING & BROADCASTING EQUIPMENT						●										●													●	
RECORDING & BROADCASTING SERVICES																											●			
RECTIFIERS																														
SATELLITE COMMUNICATIONS SYSTEMS	●									●		●																		
SATELLITE EARTH STATIONS	●									●		●																		●
SILICON SURGE SUPPRESSION COMPONENTS																														
SINGLE CHANNEL PER CARRIER EQUIPMENT	●											●																		
SMALL/MEDIUM/HIGH CAPACITY LINE TRANSMISSION																														
SOUND REINFORCEMENT PRODUCTS																										●				
SPECIAL TELEPHONE OPERATIONS & MAINTENANCE																		●												
SSPG PABX/PABX – PRIVATE						●	●														●							●		
STATIC FREQUENCY CONVERTERS																														
STATIC INVERTERS																														
STUDIO-TO-TRANSMITTER MICROWAVE LINK SYSTEMS																														
SUPERVISION MANAGEMENT & REMOTE CONTROL																														
SWITCHING SYSTEMS						●	●	●																						
TELECOMMUNICATIONS TEST EQUIPMENT																		●				●		●						
TELECOM. TESTING – DIGITAL/PCM																		●				●								
TELECOM. TESTING – FIBRE OPTIC																						●								
TELECOM. TESTING – TRANSMISSION & NOISE																		●												
TELECOM. TESTING – VOICE NETWORK MANAGEMENT						●			●																					
TELE CONFERENCING SYSTEMS (VIDEO)												●																		
TELEMETRY SYSTEMS																														
TELEPHONE ANSWERING SYSTEMS							●																							
TELEPRINTERS																														
TELEX & DATA TERMINALS																														
TERMINALS/DISPLAYS							●																							

		MESSAGE SWITCHING	MICROCOMPUTERS	MICROPHONES	MICROPROCESSOR REMOTE CONTROL SYSTEMS	MICROWAVE INSTALLATION SERVICES	MICROWAVE TRANSMISSION	MOBILE RADIO	MOBILE TELEPHONE EXCHANGES	MONITORING LOUDSPEAKERS	MULTIPLEXERS/MODEMS	NETWORK MANAGEMENT SYSTEMS	OPTICAL FILTERS	OPTICAL TRANSMISSION SYSTEMS FOR VIDEO AUDIO	OPTO-ELECTRONIC	PACKET SWITCHING	PAGING SYSTEMS	PASSIVE COMPONENTS (LAND MOBILE ANTENNAE)	PAY/CREDIT CARD TELEPHONES	PHOTOCOPIERS
61	**McDonnell Douglas Information Systems Int**											●								
62	**Mannesmann Tally GmbH**																			
63	**Mashpriborintorg**			●				●		●					●					
64	**Maxon Electronics Middle East Ltd**							●												
65	**MCL Ltd**						●													
66	**Memotec Data Inc**										●	●								
67	**Microflect Co Inc**						●													
68	**Mitec Electronics Ltd**						●											●		
69	**Morgan Laboratories Ltd**																			
70	**Moseley Associates Inc**				●		●													
71	**Motronic**							●											●	
72	**Multi Point Communications**																			
73	**Multi-Tech Systems International**										●									
74	**Multitone Communications Systems Ltd**																			
75	**Mutlitone Electronics**																			
76	**Mycomp Technologies Corp**																			
77	**Netcom (Australia) Pty Ltd**																			
78	**Nixdorf Computer AG**																			
79	**Nokia-Mobira OY**							●												
80	**Nokia Telecommunications**						●		●		●									
81	**Nytone Inc**																			
82	**OTC Australia**																			
83	**Philips Elektronikindustrier AB**																			
84	**Phillips Kommunikations Industrie AG**																			
85	**Photodyne Inc**																			
86	**Photowatt International SA**																			
87	**RC Computer A/S**											●				●				
88	**Reliance Comm/Tec**																		●	
89	**Sagem**	●	●																	
90	**Satellite Consultants International Inc**																			

	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
POWER SUPPLIES			●																							●		●		
PRINTERS & NETWORK SYSTEMS	●	●																					●							
PROGRAMMABLE PAY TELEPHONE CONTROLLERS																														
PROTOCOL TESTERS																														
PUBLIC EXCHANGES			●																	●										
RADIAL & PARTY LINE DESPATCHER SYSTEMS																														
RADIO PAGING SYSTEMS															●															
RECEIVING & TRANSMISSION (RADIO)			●	●				●		●																				
RECORDING & BROADCASTING ACCESSORIES																														
RECORDING & BROADCASTING EQUIPMENT			●						●							●					●									
RECORDING & BROADCASTING SERVICES									●							●														
RECTIFIERS																												●		
SATELLITE COMMUNICATIONS SYSTEMS			●		●			●																						●
SATELLITE EARTH STATIONS	●				●			●																						●
SILICON SURGE SUPPRESSION COMPONENTS																														
SINGLE CHANNEL PER CARRIER EQUIPMENT								●																				●		
SMALL/MEDIUM/HIGH CAPACITY LINE TRANSMISSION																				●										
SOUND REINFORCEMENT PRODUCTS																														
SPECIAL TELEPHONE OPERATIONS & MAINTENANCE																														
SSPG PABX/PABX – PRIVATE																														
STATIC FREQUENCY CONVERTERS																														
STATIC INVERTERS																														
STUDIO-TO-TRANSMITTER MICROWAVE LINK SYSTEMS										●																				
SUPERVISION MANAGEMENT & REMOTE CONTROL																														
SWITCHING SYSTEMS	●					●														●										
TELECOMMUNICATIONS TEST EQUIPMENT			●		●																							●		
TELECOM. TESTING – DIGITAL/PCM																														
TELECOM. TESTING – FIBRE OPTIC																									●					
TELECOM. TESTING – TRANSMISSION & NOISE																												●		
TELECOM. TESTING – VOICE NETWORK MANAGEMENT																														
TELE CONFERENCING SYSTEMS (VIDEO)																					●									
TELEMETRY SYSTEMS																														
TELEPHONE ANSWERING SYSTEMS			●	●							●																			
TELEPRINTERS																							●							
TELEX & DATA TERMINALS																														
TERMINALS/DISPLAYS								●																					●	

		MESSAGE SWITCHING	MICROCOMPUTERS	MICROPHONES	MICROPROCESSOR REMOTE CONTROL SYSTEMS	MICROWAVE INSTALLATION SERVICES	MICROWAVE TRANSMISSION	MOBILE RADIO	MOBILE TELEPHONE EXCHANGES	MONITORING LOUDSPEAKERS	MULTIPLEXERS/MODEMS	NETWORK MANAGEMENT SYSTEMS	OPTICAL FILTERS	OPTICAL TRANSMISSION SYSTEMS FOR VIDEO AUDIO	OPTO-ELECTRONIC	PACKET SWITCHING	PAGING SYSTEMS	PASSIVE COMPONENTS (LAND MOBILE ANTENNAE)	PAY/CREDIT CARD TELEPHONES	PHOTOCOPIERS
91	**Schrack Elektronik AG**																			
92	**Scientific-Atlanta Inc**																			
93	**Scientific Radio Systems Inc**							●								●				
94	**Sennheiser Electronic KG**																			
95	**Siemens AG Österreich**		●						●											
96	**Sony Broadcast Ltd**			●																
97	**Sperry Aerospace Division (Honeywell) Ltd**										●	●		●						
98	**Standard Electrica SA**							●											●	
99	**Standard Electrik Lorenz AG**	●																		
100	**Stanton Magnetics Inc**																			
101	**Storno A/S**							●												
102	**Swedish Telecoms International AB**							●								●				
103	**Tekelec Instruments**										●									
104	**Telecom Australia (International) Ltd**																			
105	**Telefonaktiebologet LM Ericsson**						●	●			●	●								
106	**Telespazio S.p.A**																			
107	**Telettra Española SA**						●	●			●									
108	**Teltone Corporation**										●	●								
109	**Texar Incorporated**																			
110	**James Thomas Engineering**																			
111	**Tiffen Manufacturing Corp**												●							
112	**TIW Systems Incorporated**											●								
113	**TSI (Telecommunications Services International)**																			
114	**Uni-Lab Telecommunications Ltd**					●	●	●												
115	**UNR Rohn Inc**							●												
116	**Vanderhoff Business Systems Ltd**																			
117	**Vanderhoff Communications Ltd**																		●	
118	**Voicecall Communications Pty**							●												
119	**Wang Laboratories Inc**		●									●				●				
120	**Western Multiplex Corp**						●				●									

POWER SUPPLIES	PRINTERS & NETWORK SYSTEMS	PROGRAMMABLE PAY TELEPHONE CONTROLLERS	PROTOCOL TESTERS	PUBLIC EXCHANGES	RADIAL & PARTY LINE DESPATCHER SYSTEMS	RADIO PAGING SYSTEMS	RECEIVING & TRANSMISSION (RADIO)	RECORDING & BROADCASTING ACCESSORIES	RECORDING & BROADCASTING EQUIPMENT	RECORDING & BROADCASTING SERVICES	RECTIFIERS	SATELLITE COMMUNICATIONS SYSTEMS	SATELLITE EARTH STATIONS	SILICON SURGE SUPPRESSION COMPONENTS	SINGLE CHANNEL PER CARRIER EQUIPMENT	SMALL/MEDIUM/HIGH CAPACITY LINE TRANSMISSION	SOUND REINFORCEMENT PRODUCTS	SPECIAL TELEPHONE OPERATIONS & MAINTENANCE	SSPG PABX/PABX – PRIVATE	STATIC FREQUENCY CONVERTERS	STATIC INVERTERS	STUDIO-TO-TRANSMITTER MICROWAVE LINK SYSTEMS	SUPERVISION MANAGEMENT & REMOTE CONTROL	SWITCHING SYSTEMS	TELECOMMUNICATIONS TEST EQUIPMENT	TELECOM. TESTING – DIGITAL/PCM	TELECOM. TESTING – FIBRE OPTIC	TELECOM. TESTING – TRANSMISSION & NOISE	TELECOM. TESTING – VOICE NETWORK MANAGEMENT	TELE CONFERENCING SYSTEMS (VIDEO)	TELEMETRY SYSTEMS	TELEPHONE ANSWERING SYSTEMS	TELEPRINTERS	TELEX & DATA TERMINALS	TERMINALS/DISPLAYS	
																																				91
												●	●		●										●					●						92
							●																													93
								●	●																											94
●				●	●				●	●								●	●					●	●											95
								●	●	●																										96
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●	●						●												●				●	●											●	107
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								●	●	●																										109
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																																				113
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●		●		●							●								●		●		●		●	●		●	●							117
																																				118
	●											●																							●	119
																																				120

		TEST & MEASUREMENT INSTRUMENTS	TEST & MEASUREMENT SERVICE	TEST & MEASUREMENT SOFTWARE	TEST & MEASUREMENT SYSTEMS	TEST & MEASUREMENT TRAINING	TIME DIVISION MULTIPLE ACCESS EQUIPMENT	TOWERS & GUYED MASTS	TRAINING & MANAGEMENT	TROPOSCATTER SYSTEMS	TURNKEY PROJECTS	TV BROADCASTING TRANSMITTERS	TV BROADCASTING TRANSMITTERS & EQUIPMENT	TV RECEIVING EQUIPMENT	UPS	VALUE ADDED NETWORK SYSTEMS	VF – LINE CONDITIONING	VIEWDATA	VISUAL/AUDIO	VOICE RESPONSE EQUIPMENT
1	**AEL Communications Ltd**																			
2	**Alcatel Austria Aktiengesellschaft**																			
3	**Altec Lansing**																			
4	**Applicazioni Elettrotelefoniche AET S.p.A**																●			
5	**ATS Communications Ltd**																			
6	**Auditronics Inc**																			
7	**Australian Trade Commission**																			
8	**Austria Telecommunication GmbH**										●									
9	**Aydin Corporation (West)**									●	●									
10	**BAL Components Ltd**																			
11	**Barco Industries N.V.**																			
12	**Beckman Industrial Ltd**	●																		
13	**Bell Canada International Inc**								●											
14	**Bell South Corporation**																			
15	**British Telecom Overseas Division**								●		●									
16	**Browning Labs Inc**												●							
17	**Calzarara S.p.A**																			
18	**Canon**																			
19	**Catsco Pty Ltd**																			
20	**Centro Corporation**										●			●						
21	**Christian Rovsing A/S Af 1984**								●											
22	**Cinerent AG**																			
23	**Circuit Research Laboratories Inc**																			
24	**Coherent Communications Systems Corp**																			
25	**Continental Electronics**																			
26	**Continental Microwave**																			
27	**Csiro**																			
28	**Datapro**																			
29	**Datap Systems**																			
30	**Alan Dick & Co Ltd**										●	●								

		TEST & MEASUREMENT INSTRUMENTS	TEST & MEASUREMENT SERVICE	TEST & MEASUREMENT SOFTWARE	TEST & MEASUREMENT SYSTEMS	TEST & MEASUREMENT TRAINING	TIME DIVISION MULTIPLE ACCESS EQUIPMENT	TOWERS & GUYED MASTS	TRAINING & MANAGEMENT	TROPOSCATTER SYSTEMS	TURNKEY PROJECTS	TV BROADCASTING TRANSMITTERS	TV BROADCASTING TRANSMITTERS & EQUIPMENT	TV RECEIVING EQUIPMENT	UPS	VALUE ADDED NETWORK SYSTEMS	VF – LINE CONDITIONING	VIEWDATA	VISUAL/AUDIO	VOICE RESPONSE EQUIPMENT
31	**Dornier Systems GmbH**																			
32	**Dynaudio APS**																			
33	**ECI Telecom**																			
34	**ECO Ltd**																			
35	**Electro-Voice**																			
36	**Elektronorgtechnika**																			
37	**Elit Electronica Italiana S.p.A**													●						
38	**Emcee Broadcast Products**																			
39	**Enertec Instruments**	●			●															
40	**Face Finanziaria**																			
41	**Fairlight Instruments**																			
42	**Fortel Incorporated**																		●	
43	**GN Elmi A/S**	●																		
44	**GN Netcom A/S**																			
45	**Hallikainen & Friends Inc**																			
46	**Harris Corporation-Farinon Division**								●											
47	**Heyden-Spike Ltd**																			
48	**Howe Audio Productions**																			
49	**Hubcom/Hubbard Communications Inc**										●			●						
50	**Intelligent Business Coms CP**																			
51	**Intelsat**																			
52	**Iskra**	●																		
53	**Jupiter Technology Inc**															●				
54	**Kapsch Aktiengesellschaft**				●															●
55	**Kovo Foreign Trade Corp**																		●	
56	**Lea Dynatech Incorporated**																			
57	**Leblanc & Royle Telcom Inc**							●			●									
58	**LK Products**																			
59	**Loral Terracom**																			
60	**M/A-Com Telecommunications Division**						●				●									

		TEST & MEASUREMENT INSTRUMENTS	TEST & MEASUREMENT SERVICE	TEST & MEASUREMENT SOFTWARE	TEST & MEASUREMENT SYSTEMS	TEST & MEASUREMENT TRAINING	TIME DIVISION MULTIPLE ACCESS EQUIPMENT	TOWERS & GUYED MASTS	TRAINING & MANAGEMENT	TROPOSCATTER SYSTEMS	TURNKEY PROJECTS	TV BROADCASTING TRANSMITTERS	TV BROADCASTING TRANSMITTERS & EQUIPMENT	TV RECEIVING EQUIPMENT	UPS	VALUE ADDED NETWORK SYSTEMS	VF – LINE CONDITIONING	VIEWDATA	VISUAL/AUDIO	VOICE RESPONSE EQUIPMENT
61	**McDonnell Douglas Information Systems Int**								●							●				
62	**Mannesmann Tally GmbH**																			
63	**Mashpriborintorg**	●	●		●	●								●						
64	**Maxon Electronics Middle East Ltd**																			
65	**MCL Ltd**																			
66	**Memotec Data Inc**																			
67	**Microflect Co Inc**																			
68	**Mitec Electronics Ltd**																			
69	**Morgan Laboratories Ltd**																			
70	**Moseley Associates Inc**										●									●
71	**Motronic**																			
72	**Multi Point Communications**																			
73	**Multi-Tech Systems International**																			
74	**Multitone Communications Systems Ltd**																			
75	**Mutlitone Electronics**																			
76	**Mycomp Technologies Corp**																			
77	**Netcom (Australia) Pty Ltd**																			
78	**Nixdorf Computer AG**																			
79	**Nokia-Mobira OY**																			
80	**Nokia Telecommunications**										●									
81	**Nytone Inc**																	●		
82	**OTC Australia**																			
83	**Philips Elektronikindustrier AB**																			
84	**Phillips Kommuuikations Industrie AG**																			
85	**Photodyne Inc**	●																		
86	**Photowatt International SA**																			
87	**RC Computer A/S**															●				
88	**Reliance Comm/Tec**	●													●		●			
89	**Sagem**																			
90	**Satellite Consultants International Inc**								●											

		TEST & MEASUREMENT INSTRUMENTS	TEST & MEASUREMENT SERVICE	TEST & MEASUREMENT SOFTWARE	TEST & MEASUREMENT SYSTEMS	TEST & MEASUREMENT TRAINING	TIME DIVISION MULTIPLE ACCESS EQUIPMENT	TOWERS & GUYED MASTS	TRAINING & MANAGEMENT	TROPOSCATTER SYSTEMS	TURNKEY PROJECTS	TV BROADCASTING TRANSMITTERS	TV BROADCASTING TRANSMITTERS & EQUIPMENT	TV RECEIVING EQUIPMENT	UPS	VALUE ADDED NETWORK SYSTEMS	VF – LINE CONDITIONING	VIEWDATA	VISUAL/AUDIO	VOICE RESPONSE EQUIPMENT
91	**Schrack Elektronik AG**																			
92	**Scientific-Atlanta Inc**						●		●		●			●						
93	**Scientific Radio Systems Inc**										●									
94	**Sennheiser Electronic KG**		●																	
95	**Siemens AG Österreich**	●		●							●					●		●	●	
96	**Sony Broadcast Ltd**								●										●	
97	**Sperry Aerospace Division (Honeywell) Ltd**																			
98	**Standard Electrica SA**								●		●									
99	**Standard Electrik Lorenz AG**																			
100	**Stanton Magnetics Inc**																			
101	**Storno A/S**																			
102	**Swedish Telecoms International AB**								●											
103	**Tekelec Instruments**	●			●															
104	**Telecom Australia (International) Ltd**								●											
105	**Telefonaktiebologet LM Ericsson**										●				●					
106	**Telespazio S.p.A**																			
107	**Telettra Española SA**						●		●		●									
108	**Teltone Corporation**																			
109	**Texar Incorporated**																			
110	**James Thomas Engineering**																			
111	**Tiffen Manufacturing Corp**																			
112	**TIW Systems Incorporated**																			
113	**TSI (Telecommunications Services International)**								●											
114	**Uni-Lab Telecommunications Ltd**								●		●									
115	**UNR Rohn Inc**																			
116	**Vanderhoff Business Systems Ltd**	●			●															
117	**Vanderhoff Communications Ltd**	●			●															
118	**Voicecall Communications Pty**																			
119	**Wang Laboratories Inc**								●											
120	**Western Multiplex Corp**																			

Advertisers' Index

AEL Communications Ltd	248, 249	1
Alcatel Austria	128, 129	2
Altec Lansing	144, 145	3
Applicazioni Elettroteleforiche AET SpA	108, 109	4
AT Austria Telecommunication Ges mbH	106, 207	5
ATS Communications Ltd	286, 287	6
Auditronics Incorporated	462, 463	7
Australian Telecom (International) Limited	184, 185	8
Australian Trade Commission	9 – 17	9
Aydin Corporation (West)	24, 25	10
Barco Video & Communications NV	480	11
Beckman Industrial Ltd	278-281	12
Bell Canada International Incorporated	66	13
BellSouth International Inc	22, 23	14
British Telecom Overseas	58, 59	15
Browning Laboratories Incorporated		1116
Calzavara SpA	120, 121	17
Canon Europa NV	276, 277	18
Cats Company Pty Ltd	110, 111	19
Centro Corporation	112, 113, 234, 235, 458-459	20 21
Christian Rovsing A/S af 1984	70	22
Cinerent Filmequipment Service AG	471, 472	23
Circuit Research Laboratories Incorporated	436/437	24
The Commonwealth Scientific and Industrial Research Organisation (CSIRO), SIROTECH Ltd	349-356	25 26
Continental Electronics	372	27
Continental Microwave Ltd	388, 389	28
Datap Systems	114, 115	29
Datapro Services SA	302, 303	30
Alan Dick & Company Ltd	438, 439	31
Dornier System GmbH	370 371	32
ECO Ltd	466, 467	33
Electro-Voice Inc	476-480	34
Electronogtechnika	298, 299	35
Elit Elettronica Italiana SpA	475	36
G N Elmi	202, 203	37
EMCEE Broadcast Products	469, 470	38
Enertec Instruments	192	39
FACE Finanziaria	60, 61	40
Fairlight Instruments Pty Limited	490-493	41
Fortel Incorporated	468, 469	42
Hallikainen & Friends	461	43
Harris Farinon	474, 475	44
Heyden-Spike Limited	68, 69	45
Hubbard Communications Inc	362, 363	46
Intelligent Business Communications Corporation	198, 199, 200, 201	47
Intelsat	368, 369	48
Iskra	284, 285	49
Jupiter Technology Inc	290, 291	50
Kapsch AG	116, 117	51
KOVO Foreign Trade Corporation	180	52
L E A Dynatech	482, 483	53
LeBlanc & Royle Telcom Inc	444, 445	54
L K Products	220	55
Loral TerraCom	62, 63	56
M/A-Com Telecommunications Division	318	57
Mannesmann Tally GmbH	292, 293	58
Mashpriborintorg	128, 129	59
Maxon Electronics Middle East Ltd	244, 245	60
MCL Inc	486, 487	61
Memotec	204, 205	62
Microflect	498-499	63
Mitec Electronics Limited	366, 367	64
Morgan Laboratories	448-49	65
Moseley Associates Inc	494-496	66
Motronic	196, 197	67
Multi Point Communications Ltd	364, 365, 454-455	68
Multi Tech Systems	296, 297	69
Multitone Communications International	236-239	70
Mycomp Technologies Corporation	456, 457	71
NetComm (Aust) Pty Ltd	138, 139	72
G N Netcom	300, 301	73
Nixdorf Computer AG	274, 275	74
Nokia Telecommunications	246, 247, OBC	75
Nytone Electronics	440, 441	76
OTC Australia	298, 299	77
Philips Elektronikindustrier AB	294, 295	78
Philips Kommunikations Industrie AG	181-183	79
Photodyne Incorporated	206	80
RC Computer	282, 283	81
Reliance Comm/Tec	188, 189	82
Rohn	449	83
Sagem, Telex and Office Automation Division	288, 289	84
Satellite Consultants International Inc	360, 361	85
Schrack Elektronik AG	194, 195	86
Scientific-Atlanta	358, 359	87
Scientific Radio Systems Incorporated	193	88
Sennheiser Electronik	442-443	89
Siemens AG Osterreich	118, 119	90
Standard Elektrik Lorenz AG	219	91
Stanton Magnetics Inc	484, 485	92
Sony Broadcast Ltd	460	93
Sperry Inc	136, 137	94
Swedish Telecoms International AB	64, 65	95
Tekelec Instruments	311	96
Telefonaktiebolaget LM Ericsson	18-21	97
Telespazio	357	98
Telettra Espanola SA	146-151	99
Teltone Corp	186, 187	100
Texar In	487, 488	101
James Thomas Engineering Ltd	452-453	102
Tiffen Manufacturing Corp	446, 447	103
T I W Systems International	102-105	104
UNI-LAB Telecommunications Ltd	140-143, 240-241	105 106
Vanderhoff plc	122-127	107
Voicecall Communications Pty Limited	242, 243	108
Wang Laboratories Inc	304-307	109
Western Multiplex Corporation	190, 191	110

Are your exchanges fighting like cats and dogs?

The question of exchange compatibility can be a big problem for telecom administrations upgrading their networks or fulfilling various subscriber needs. Switching needs today can range from tens of thousands of urban subscribers per exchange to a couple of dozen country folk plugged into a small local exchange, but no manufacturer seems to offer an exchange for every contingency. The result can be a madhouse.

The Emirates Telecommunications Corporation (Etisalat) operates a 100% digitalized telephone network throughout the United Arab Emirates. Originally comprising switching systems by Ericsson and NEC, the network is now being augmented by a total of 31 state-of-the-art DX 200 exchanges developed and manufactured by Nokia Telecommunications.

In the UAE, bringing the standard of rural telecommunications to urban levels meant selecting a high performance, medium capacity digital exchange which would both maximize network efficiency, and interface with the country's existing telecoms infrastructure. In reviewing the possibilities, it soon became obvious that the exchange offering the optimum solution on both counts was the DX 200.

Tailoring systems to meet an infinitude of individual requirements is a Nokia Telecommunications speciality. With over 500 DX 200 exchanges in operation world-wide, Nokia came well prepared to tailor the UAE's DX 200 exchanges to full compatibility with the country's existing systems. And in the UAE, the notion of compatibility also included full ISDN readiness, another feature built into each DX 200 exchange.

Today, with most of the DX 200 exchanges commissioned, the Etisalat network is interworking in perfect harmony. So if your problem is incompatibility, give us a call — we know all about harmonious coexistence.

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